THE NORTHERN YUKON: AN ECOLOGICAL LAND SURVEY

CANADA. LANDS DIRECTORATE

Ecological Land Classification Series, No. 6

THE NORTHERN YUKON: AN ECOLOGICAL LAND SURVEY

by

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Front cover: View south over the valley of the headwaters of the Trail River in the British Mountains (2.06 Upper Trail River Ecodistrict); felsenmeer (blockfields) in the foreground; barren ground caribou of the Porcupine herd on tundra-covered colluvial slopes in the middle ground; sparsely vegetated to barren mountain slopes in the background.

Back cover: Portion of a Landsat color I mosaic of part of the study area and adjacent Alaska; in this false-color image, red and orange represent vegetated surfaces, blue or black is water, and light tones are highly reflective surfaces such as bare rock or ice; north is toward the top of the image; the area shown measures approximately 150 km across; the rectangular, oriented lakes of the Old Crow Flats dominate the lower center of the image; the British Mountains are seen at the upper left, and include a large icing of the Firth River.

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FOREWORD

The environment of the northern Yukon is well known in Canada for its diverse and unique land resources and for its archaeological and historical importance. The interests expressed by a host of wildlife, conservation, natural history, and native groups throughout Canada as well as abroad testifies to its national and international significance. The concerns cover a gamut of biological, physical, archaeological, and historical features.

The Lands Directorate, at the request of Parks Canada and the Canadian Wildlife Service, had the opportunity to contribute to the early appraisal of this extensive area by conducting an ecological land survey. This survey served to provide a regional characterization of the wide range of land resources of the northern Yukon within a common framework while at the same time enabling Lands Directorate staff to research and further implement a more integrated approach to ecological land classification. The maps produced for the study also represent alternative techniques for the presentation of mapped information.

The Lands Directorate is equally concerned with encouraging ecologically based approaches to land planning and environmental impact assessment. As we have in the northern Yukon, throughout Canada we have attempted to provide advice and assistance in the realm of land surveys and land use planning. This applies to all levels of government as well as to industry and the private sector. In doing so, we hope to foster appropriate measures for the conservation, protection, and use of Canada's land resources.

R.J. McCormack
Director General

PREFACE

The northern Yukon is a remarkable collection of landscapes and natural resources. Some of these have received much public attention, such as the coastal plains and their importance to the Porcupine caribou herd of northwest Canada and adjacent Alaska. Others, although unique to Canada, are less well known, an example being the area, greater in extent than some provinces, which was never glaciated; a consequence of this is that the northern Yukon displays landforms and vegetation relationships seen nowhere else in this country.

At the same time, however, the northern Yukon is bounded by three regions of current or potential economic development. To the west are the oil and gas discoveries and production facilities of Prudhoe Bay and the North Slope of Alaska. To the north is the Beaufort Sea with its potential for offshore hydrocarbon exploration and production. To the east lies the Mackenzie Delta, a nodal region for settlement, transportation, and shipment of oil and gas from both onshore and offshore production sites. Caught in this web of industrialization, the pristine environment of the northern Yukon is now subject to pressures for pipeline construction, marine terminal siting, and aggregate removal in support of both. Such development could lead to environmental impacts of accidental spills, disposal of oiled debris, noise and other harassment of wildlife, defacement of important prehistoric and historic archaeological sites, and visual intrusion into areas of outstanding natural beauty.

In response to these natural values and development pressures, several public interest groups and government agencies have expressed concern that the area be governed and/or protected in some way to conserve its environmental resources. Leaving aside the alternate strategies favoured by these groups and agencies, it became apparent to the federal government that policy formulation, regional planning, land claim negotiations, and resource management could only be conducted rationally if an information base, portraying all environmental aspects over the entire region, was available. Consequently, Indian and Northern Affairs Canada and Environment Canada collaborated in sponsoring this ecological land survey of the northern Yukon, with a view to a potential national wilderness park and/or some kind of wildlife reserve. The ecological land survey approach was selected for this study because it is flexible, providing information for a broad range of planning needs, and it can be carried out rapidly and at relatively low cost. For the 35,130 square kilometer northern Yukon study area, the survey cost (not including salaries) averaged $1.43 per square kilometer.

Initially, this work was contracted to the Pacific and Yukon regional office of the Lands Directorate of Environment Canada, with terms of reference set down by the Natural Resource Division of Parks Canada. These terms of reference placed certain limits on time and money. However, because of other priority projects elsewhere in the Yukon, the Lands Pacific and Yukon staff could not meet the time limit and therefore passed the contract to the Lands Directorate headquarters. Because our mandate focusses on research and development of ecological land survey methods and applications, we chose to add several objectives of our own, along with additional resources.

Traditionally, the broader levels of generalization in the classification hierarchy of ecological land survey tended to focus on separate and more thematic components of the environment. The ecoregion, for example, was largely the mapped extent of regional eco-climate, whereas the ecodistrict corresponded to a physiographic unit. As such, they lacked a holistic perspective of land and failed to integrate other components such as water, soils, wildlife, and human elements. Because of the diversity of environmental resources and concerns in the northern Yukon, we felt that the ecoregion and ecodistrict levels would have to be defined from a holistic perspective. We chose to adopt a descriptive landscape approach which emphasized, on a scale-related basis, what the predominant and stable occurrences were, and to do this from an integrated point of view. We have tried to retain information on ecological processes and relationships through explanatory descriptions of mapped units and by the placement of mapped lines to contain distinctive process-response systems appropriate in size to the level of mapping detail.

The melding of disciplines employed in this ecological land survey also required some innovations in data presentation. The accompanying maps, for example, represent different formats in portraying mapped information to facilitate communication among

varied disciplines as well as non-technical personnel. We also experimented with coding of mapped data for ease of computer entry and manipulation. From this, we have learned some positive aspects (eg the advantages of self-exploratory alphanumeric codes), as well as things to avoid (eg all-number codes).

Landsat colour transparencies and prints were found to be particularly instructive tools for standardizing map units and, to some degree, characterizing ecodistricts. Landsat colour mosaics were equally useful for an overall appreciation of the area at the ecoregion level. We have since adopted the routine production of Landsat mosaics for our current ecological land survey studies in the Northwest Territories. As well, we have instituted a Canada-wide collection of Landsat transparencies in support of Environment Canada's land survey activities.

These and other lessons have been applied to our subsequent efforts in ecological land survey, both in conducting field programs in the north and in providing advice and guidelines to other federal, provincial, and territorial agencies. As such, this northern Yukon survey should be considered as just one contribution to a Canada-wide effort in refining and standardizing natural resource surveys. Not all that is contained herein would we necessarily do again. It is what we decided on at the time (1977-79), and the reader is encouraged to view this report and accompanying maps as one iteration in the process of developing methodology in ecological land survey.

Pending settlement of native land claims and the designation of management regimes by federal and territorial governments, the data from this survey have only been applied directly in helping to establish a federal position in respect of the preferred extent of any land allocation.

We would like to acknowledge, with thanks, the agencies and individuals who helped make possible the research project and the publication of this report and accompanying maps. Parks Canada, at the time a service of Indian and Northern Affairs Canada, and the Canadian Wildlife Service of Environment Canada provided funds for fieldwork and many other expenses, such as complete aerial photograph and Landsat coverage, photo processing, and typing of the original unpublished report. The Department of National Defence assisted us in arranging fuel caching and accommodation at the northern Yukon DEW Line sites. The support of the DEW Line staff greatly helped to make our fieldwork successful. Okanagan Helicopters Limited, and particularly pilot Jeff Bickerstaff, ensured that all of our helicopter requirements were met. Ramair of Inuvik cached our fuel, transported field equipment, and provided us with an excellent reconnaissance overflight and with access to the Old Crow Flats. The ecoregion and ecodistrict maps and all line illustrations in the report were prepared by the Environmental Conservation Service (Environment Canada) Drafting Division. Ian MacNeil of Parks Canada kindly loaned us his slides of the northern Yukon; some of these are reproduced, notably for the Old Crow Flats and the White Mountains ecodistricts. Portions of the final report were typed by Nancy Archambault of Systemhouse Limited and Hélène Villeneuve of the Lands Directorate. Leslie Lee edited the report and Ruth Tabacnik of Words Associated prepared the report for final paste-up. Jean Thie of the Lands Directorate provided field assistance; he along with many others have, through discussions, provided instructive guidance and innovative ideas.

Ed Wiken was project leader and was mainly responsible for coordinating the terrain input. David Welch, Gary Ironside, and David Taylor coordinated, respectively, hydrology, vegetation, and wildlife inputs. David Welch and Ed Wiken provided most of the aerial photograph and Landsat interpretation and mapping of ecological units. All authors contributed in various degrees to the review amd formulation of all sections of the report. Gary Ironside coordinated final preparation of the report and maps.

As well as acknowledging people, the land of the northern Yukon itself deserves special mention. It gave us many sights and moments which will last in our memory. These include: the sheer-walled canyons of the Firth River; the sparkling, mosquito-free oases of the 'naleds' (aufeis or icings); the vast, sweeping pediments remaining as principal testimony to the absence of glaciation in the geologic past; the remarkable stand of 15 m balsam poplars, in striking contrast to the stunted white spruce of the surrounding landscape; and the ankle-twisting tussock tundra across which man walks with difficulty, but over which caribou and grizzly bear can run almost effortlessly.

In particular, the subgroups of the Porcupine caribou herd are indeed breathtaking to watch. A group of several thousand caribou moving across the land, its individuals alternately running and stopping to eat, gives the impression, from a distance, of a single amoeba-like organism creeping inexorably over tundra, across water, and over rocky uplands; physical barriers appear not to exist for the

moving caribou. Similarly, one may occasionally see several thousand caribou clustered on seemingly inaccessible and barren mountain tops, apparently to seek temporary relief from mosquitoes and blackflies. Finally, to land on a high ridge, surrounded on three sides by extensive pediments, and to see a whole panorama filled, here and there, with groups of distant caribou, each containing hundreds or thousands of animals -- that truly was a memorable sight.

Ed Wiken
David Welch
Gary Ironside
David Taylor

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SECTION A

INTRODUCTION

BACKGROUND AND SCOPE

The northern Yukon Territory is one of the more diverse northern Canadian ecosystems. It contains marked variations in phenomena such as geology, geomorphology, climate, vegetation, wildlife, and water. As this area has been relatively untouched by human occupation, the pristine qualities of the land have been maintained. Several of these qualities are of striking distinctiveness and, in some cases, are quite unique. Tangible evidence to this effect is provided by the manifold forms of interests expressed in this area. For example, the northern Yukon Territory is: an integral segment of the arctic wildlife range for one of the world's last great caribou herd -- the Porcupine herd; an important locale for North American archaeological and paleological studies; an area containing several ecological sites under the International Biological Program as well as several sites for possible inclusion in UNESCO's World Heritage List; a significant hunting and trapping territory for native groups; a major breeding, staging, and moulting site for waterfowl; and one of the few Canadian landscapes which possesses large tracts of land unmodified by the Quaternary glaciation. In recognition of these concerns and their national and international significance, Parks Canada requested that the Lands Directorate provide an ecological data base that would allow appropriate management and planning strategies to be formulated.

To acquire the baseline data, an exploratory ecological land survey was conducted during a seven-day period in July and August of 1977. The information base is orientated predominantly to ECODISTRICTS; some information is also geared to the refinement of existing ECOREGIONS. The survey utilized an interdisciplinary team composed of scientists with backgrounds in geology, geomorphology, climatology, pedology, hydrology, botany, and biology. During the field operations, the team verified the various boundaries and contents of map units which had been recognized through the analysis of aerial photographs and satellite images. The field session involved a reconnaissance overflight in a fixed-wing aircraft plus a limited amount of helicopter work to furnish further low-level reconnaissance and selected ground checks. The study area, illustrated in Figure A1, encompasses approximately 44,000 km^2 and lies within the 1:250,000 Canadian topographical series 117 A/B/C/D and 116 N/O/P. The maps provided for each level of generalization (eg ecoregion and ecodistrict) are respectively at the scales of 1:1,000,000 and 1:500,000. Owing to the paucity of field checks and of supplementary information from other baseline studies in parts of this study area, the results in this report should be considered exploratory in detail.

Beyond the ecological land classification of the area, some work was devoted to evaluations of the data. This, however, was never an integral part of the original terms of reference. They are discussed here mainly in the sense of what value they could be in supporting planning and management judgements.

GENERAL ENVIRONMENTAL SETTING

Biological and physical forces have, over millions of years, been molding the environment of the northern Yukon. The duration and magnitude of these forces have been dissimilar over the land surface. As a result, various forms of terrestrial ecosystems have emerged. To provide a general understanding of the resulting milieu, some of the more dominant forces are discussed.

Physiography

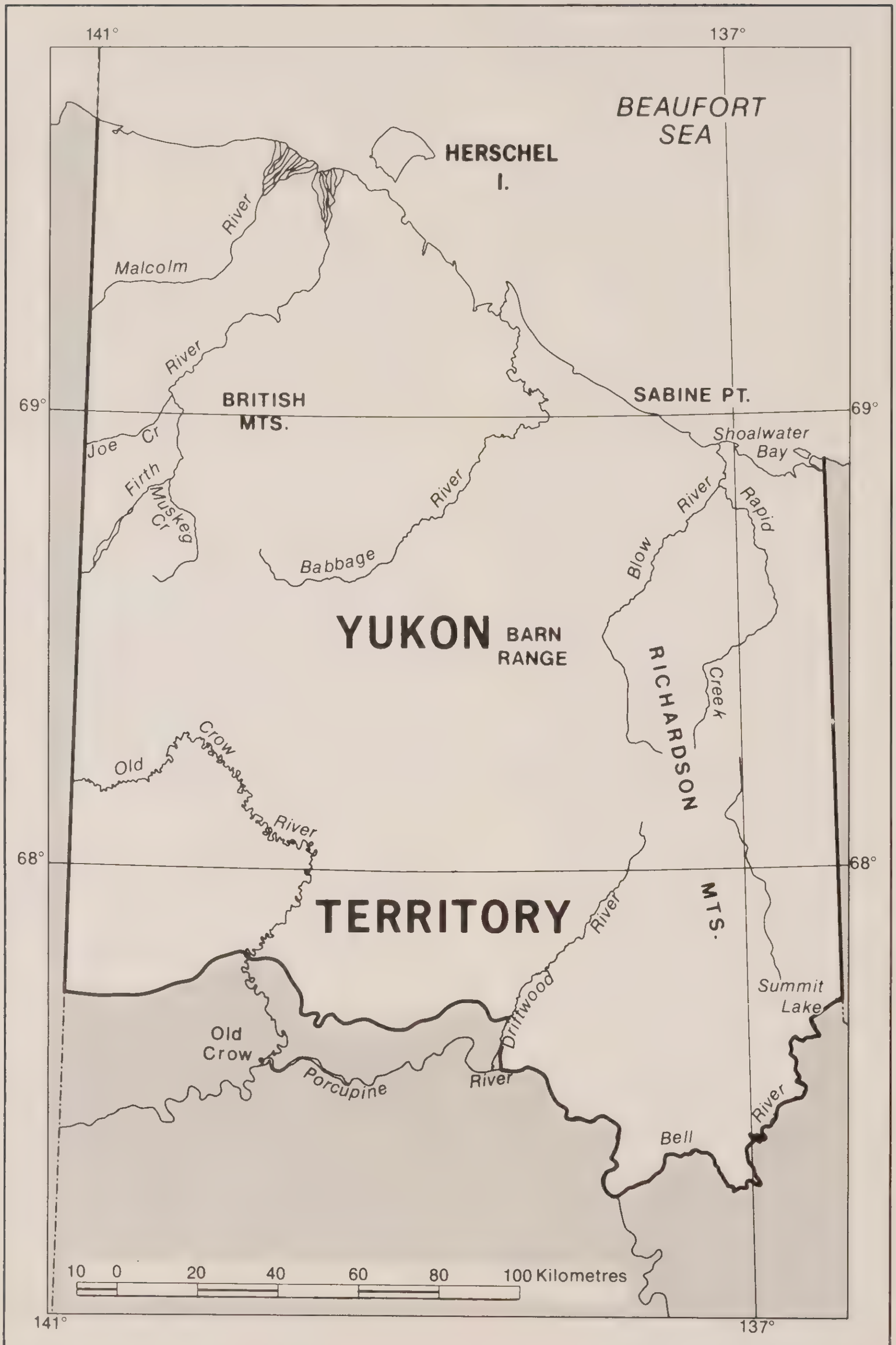
The geological history of this area spans at least the last 600 million years. Major events which have occurred and shaped the earth's surface include: the shifting, folding, and faulting of large land masses; the denudation of the land surface by periglacial and non-glacial erosional processes; and the repeated partial invasion by ice during glacial epochs. Since these events have been predominantly regional in extent, the configuration and composition of the earth's crust is distinctive.

The northern Yukon consists of at least three dominant physiographic units. The bulk of the land mass is occupied by chains of mountains which parallel each other along a northwestern axis. These mountains form a wedge which separates a coastal plain from an interior basin (see Ecoregion Map).

i) The coastal plain is a narrow and smooth-surfaced belt of land which parallels the entire Yukon coastline. Like the mountains to the south, this plain continues latitudinally into both the Northwest Territories and Alaska. It consists primarily of unconsolidated materials deposited during glacial epochs. This material slopes gently upwards from the sea to a general elevational mark of 150 m, a contour that marks the northern edge of the mountains.

ii) The chains of mountains are composed mostly of sedimentary formations of the Mesozoic and Palaeozoic eras. The axis of

Figure A1: The study area



these mountains trends northwesterly and possesses parallel ridgelines with altitudes ranging from 1,500 m towards western and eastern extremities to less than 1,100 m in the central portion. These chains of mountains are interrupted primarily by the valleys of the Babbage and Blow rivers. These rivers flank the central Barn Range, which are relict mountains generated by differential erosion of bedrock formations. As weathering processes have played a major role here, the valley bottoms and side slopes are extensively mantled with debris and the ridges are subdued. The British and Richardson mountains, which abut the Barn Range on the west and east respectively, are, by contrast, tectonic and structural mountain types. Uplift, faulting, and gentle folding are prominent features. Peaks are typically rugged and the relief is abrupt with mountain slopes dipping sharply into the valleys. Areas of bare or shattered rock are extensive. The intermontane areas demonstrate several large pediments.

iii) The interior basin consists of the Old Crow Flats and environs. The Flats are an almost level plain, at an elevation of roughly 325 m, of lacustrine sediments which are often overlaid with a deep organic blanket. Shallow lakes abound in the Flats, forming a near-waterscape, and meandering streams and rivers are deeply incised below lake levels. Drainage from the basin is southerly, and streams originate in the encircling mountains. Upland areas around the Flats consist of a band of slightly undulating pediment surfaces. In some cases these surfaces are overlaid with shallow eolian deposits. Lakes in this area are few.

Climate

The climate of this vicinity is frequently termed subarctic continental. The southern limit of this climate usually coincides with the poleward treeline or with the mean 10°C value recorded for the warmest month. As the temperature would suggest, the climate is rather severe; it is characterized by long winters with little daylight and by short summers with nearly continuous sunshine. The long periods of insolation compensate for the short growing season. The mean daily temperatures in the winter are commonly below -20°C, whereas those in the summer are slightly above 3°C. This temperature regime promotes continuous permafrost conditions and a tundra plant cover. Precipitation at all times of year is light because of the predominance of cold air and the low absolute humidity. The total annual accumulation is often under 13 cm. The weather regimes affecting this area are influenced by the physiographic setting as well as by the adjacent sea. The dominant air masses and pressure systems which have an impact here stem from two maritime areas. Pressure systems formed on the Polar or Maritimes Arctic front over the Gulf of Alaska frequently invade the northern Yukon. However, because of the compact mountain barrier in Alaska, this system finds easiest access to the Yukon by sweeping along the northern coast. The other major system is created over the Beaufort Sea; it commonly introduces cold polar air on its southerly course. Much of this is, in turn, barred from penetrating the interior by the mountainous chain.

Vegetation

Cold temperatures, a short growing season, and low rainfall have a marked effect on the plant life. The vegetation is largely arctic tundra, but this grades into less luxuriant alpine tundra with increasing elevation and into taiga or forest-tundra ecotone with decreasing degrees of latitude.

i) The arctic tundra like the alpine tundra is essentially treeless. The vegetation consists largely of sedges interspersed with low-growing or trailing shrubs such as willow, dwarf and shrub birch, Labrador tea, and cranberry. Ground cover is fairly continuous.

ii) For the alpine tundra, complete vegetative covers seldom occur. Vegetation cover is often in the form of scattered patches and stripes. Typical plants are mountain avens, alpine bearberry, and saxifrages.

iii) Taiga is a commonly recognized transition zone between tundra and boreal forest. Its northernmost extent represents the poleward timberline. Tree stands are typically open and predominantly of stunted white spruce. The understory is diverse and may include species characteristic of the tundra.

Wildlife

The world's largest caribou herd inhabits the northern Yukon. Other animals which are prevalent in the study area are grizzly bears, arctic fox, arctic ground squirrel, whistling swans, snow geese, other waterfowl, and a variety of shorebirds and raptors.

SECTION B

METHODOLOGY

INTRODUCTION

An ecological land survey is a process that usually consists of three major parts (Figure B1). While the steps are only generally introduced here, greater detail is given in other literature (Wiken, 1980; Wiken and Welch, 1980).

The first part or step is termed the Survey Proposal. Within this step, a dialogue between the client and the survey team is encouraged. In this particular case, we examined the terms of reference and held several meetings with Parks Canada staff to clarify individual points and to suggest changes in light of their desired goals. These meetings were held prior to field work as well as during the data synthesis and evaluation.

The second step in an ecological land survey constitutes the primary focus of this report — the ecological land classification. In particular, it is aimed at one level of generalization within this system — the ECODISTRICTS. To provide a broader framework within which to fit these ecodistricts, the existing ecoregions were examined and modified as circumstances required.

Following the ecological classification of the land, we devoted some effort to developing a number of evaluations which would have particular significance to this area. They involved current or anticipated land uses.

ECOLOGICAL LAND CLASSIFICATION CONCEPTS

For the land classification, we have, to a certain degree, followed the traditional Canadian concepts of land region and land district. The focus, however, was opened towards a more ecological perspective. Instead of being biassed to vegetation at the regional level and physiography at the district level, we stressed the notion that many ecological components interplay at all levels. Following this idea we substituted 'eco' for land. Hence, the terms ecoregions and ecodistricts were used.

Taken in the ecological sense, land consists of at least five interacting components: climate, terrain (soils, bedrock, and landforms), hydrology, vegetation, and wildlife. The nature and composition of these components tend to vary geographically; land ecosystems therefore acquire distinctive assemblages. Some of the broad generalizations are ecosystems such as the Boreal Forest or the Arctic Tundra. More specific ecosystems could be thought of in the context of sloughs and meadows. Regardless of the size, each tract of land can be viewed as having recognizable boundaries and internal unity of biological and physical characteristics. To account for the various levels of generalization, the approach termed 'ecological land classification' professes to a hierarchic system.

The levels and approximate map scales are as follows:

Ecoprovince	1:5,000,000 to 1:10,000,000
Ecoregion	1:3,000,000 to 1:5,000,000
Ecodistrict	1:500,000 to 1:1,000,000
Ecosection	1:50,000 to 1:250,000
Ecosite	1:10,000 to 1:25,000
Ecoelement	1:2,000 to 1:5,000

In certain cases, the use of hierarchy invokes a dichotomy of thought, in that to some this means that units are derived either by logical division from above or by assembling upwards from detailed observations. From a practical standpoint, there is often a little of both, as each route tends to substantiate or modify the results of the other throughout the classification process.

In common, ecoregions and ecodistricts are ecosystems — areas of land which tend to endure and cohere as a unit over the long term. Their distinctiveness is manifested in a recognizable ecological identity which is based on the ecosystem's inherent and unified sets of biological and physical characteristics.

Under the term 'characteristics', we have included various items. Beyond the basic components of any ecosystem (eg climate, terrain, hydrology, flora, and wildlife), we include their relationships. These are the time, processes, and systems relationships which exist within or between adjacent or geographically separated ecosystems or their parts. Pattern is also an integral characteristic and it is applied here to cover the vertical and horizontal arrangements of a component (eg vegetation structure, soil horizons, or toposequences) or components. Lastly, abundance is used to ascribe the relative proportion or quantity of components or ecosystems.

In conducting an ecological land survey, it is generally accepted that the knowledge from a number of disciplines must be involved in recognizing ecologically significant units of land. Briefly, the recognition criteria used in this study are outlined in Table B1. As with most classifications, the criteria are not entirely mutually exclusive as each grades into the other.

Figure B1: Major steps in an ecological land survey

Table B1: Levels of generalization and their approximate parallel with factors used for recognition

Level of Generalization	Geomorphology	Soils	Vegetation	Climate	Water	Map Scale Used
ECOREGION	Regional forms or assemblages thereof	Associations of subgroups	Plant regions	Macro to Meso	Sub- and large river basins	1:1,000,000
ECODISTRICT	Assemblages of local forms or individual regional landforms	Associations of families or subgroups	Plant districts	Meso to large micro	Sub-basins and small watersheds. Assemblages of small and intermediately sized lakes	1:500,000

ECOLOGICAL LAND CLASSIFICATION PROCEDURE

The classification procedure essentially involves three phases: prefield, field, and postfield. These phases overlap in the continuum of activities required to carry out an ecological land survey. The general procedure is illustrated with the ecodistricts.

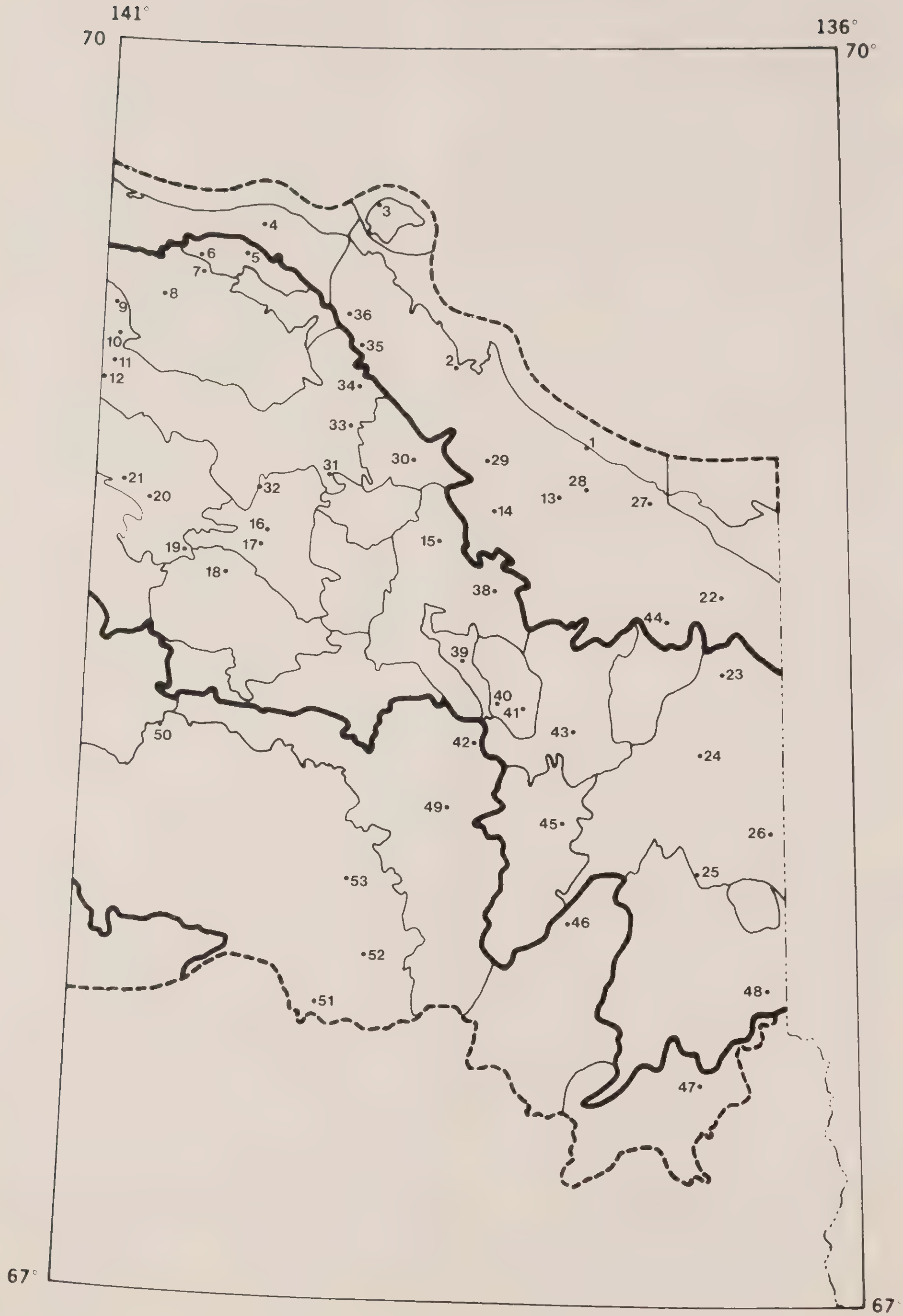
Prefield work consisted of pretyping aerial photographs and LANDSAT imagery with mapping units, of gathering available and existing background information, of planning sites for field inspection, and of interdisciplinary dialogue.

Ecodistricts were recognized by both division of ecoregions and assembly of their subsystems, ecosections. After reviewing selected reports and photographs of the northern Yukon, ecosections were tentatively recognized and delineated on air photographs of scale 1:57,000. This was done as background. Each unit was recognized by inherent phenomena such as topograhic breaks, landforms, rivers and lakes, vegetation cover, soil materials, patterned ground, etc. In conjunction, we made mosaics of 1:1,000,000 LANDSAT images and 1:500,000 topographic maps. This gave us an overall perspective of the survey area. Previously published maps also exist of very generalized geology, physiography, and ecoregions. Although these were often incomplete and at small scales, these maps were overlaid with our mosaics to help interpret tones, shapes, and patterns on the LANDSAT and aerial photographs.

Only after having reference to both the broader and more detailed levels did we feel confident in mapping and describing meaningful ecodistricts.

At scales of 1:500,000 to 1:1,000,000, the main trends apparent are the gross features related to tectonics, geology, vegetation, hydrology, climate, and geomorphology. On LANDSAT imagery, certain expressions of surface form and materials are visible. The first are major hills and valleys as seen through illumination contrasts. With low sun angles at high latitudes, this frequently means shadow. Secondly, surfaces devoid of a complete vegetation cover reflect in the grey to white colour range of LANDSAT colour composites. In our area, these are areas of bare rock, felsenmeer, or colluvium, alternately devoid of vegetation, with crustose lichens on rock, or alpine tundra forming an incomplete cover on residuum or colluvium. White images denote limestone or dolomite, the greys represent clastic rocks, medium browns indicate moraine, and so on. Thirdly, black or blue images depict lakes. These indicate physiography by their collective shapes, percent cover on the landscape, and mean and range of sizes. Fourthly, drainage patterns can be seen by virtue of the rivers themselves, the repeated size and orientation of valleys, or willows and wet ground vegetation along seepage drainageways.

Figure B2: Field stop locations



Each of these characteristics combined, by their presence or absence, percent cover, mutual proportions, reflectances, etc. allow the eye to recognize distinct map units. Once seen, their exact extent and limits were derived from the corresponding groups of ecosections delineated on the aerial photographs.

Field work allowed the field team to verify the prefield work, especially imagery analysis. The first day of field work concerned a general overflight of the study using a fixed-winged aircraft. Over the next eight days, a helicopter was used to gain access to 48 preselected sites and a float plane was used to reach five other sites (Figure B2). The preselection of these 53 sites was done to minimize flight time, to obtain representative sites and to pick sites which were near the interface of several map units. The latter allowed us to check several delineations at one stop. Owing to the constraints and objectives of the survey, we averaged one landing site per 651 km^2, one stop for each 69 km flown, roughly seven stops per day, and 30 minutes per stop. These stops allowed us to gather data and infill areas of uncertain knowledge.

Postfield work concerned the compilation and synthesis of the field and prefield data. The results invariably mean modifications of existing material.

Once the field team discussed the results in total, the ecological land classification was finalized. The results were expressed in cartographic and textual forms. Much of this is contained in the following sections.

SECTION C

ECOREGIONS

INTRODUCTION

Four ecoregions extend into the study area. They are discussed to provide background for the ecodistricts. Proceeding from the northernmost area, they are the Northern Coastal Plain, the Northern Mountains, the Old Crow Basin, and the North Ogilvie Mountains ecoregions. The dominant descriptive characteristics of each and their geographical distribution are depicted on the Ecoregion Map. These four ecoregions are part of a larger and more generalized ecosystem -- the Subarctic Ecoprovince.

Ecoregions of various types have been outlined in previous reports. The earliest study (Zoltai and Pettapiece, 1973) did not deal with the mountainous areas but examined, at a schematic level of intensity, the surrounding vicinities; the following study (Oswald and Senyk, 1977) provided complete coverage but the level of intensity remained much the same. Much of the material which we will discuss concurs with their findings. However, because we were able to increase the intensity to the exploratory level, modifications in boundaries and descriptions are introduced owing to the increased detail secured. Where possible, the existing names for ecoregions were retained so as to permit continuity with previous studies.

Before discussing each of the four ecoregions, the concepts behind the map units and the definitions may need some clarification as we have taken a slightly different approach. Map units should not necessarily be equated with what is conceptualized as a singular ecoregion. Cartographic constraints and relative complexity of the natural setting may dictate that two or more distinctive ecoregions will get lumped together into a composite type map unit. In our case, the Northern Coastal Plain is the only mapping unit which could be described as a 'pure' unit; the others contain a mixture of at least two which cannot be readily separated at the map scale of 1:1,000,000.

Ecoregions are loosely defined as areas of land that possess a recognized common identity from a regional and ecological perspective. In comparison, their subsystems -- the ecodistricts -- are more inclusive and less variable with respect to biological and physical characteristics. The commonalities displayed at the ecoregion level are not dictated by vegetation alone but by a combination of this component along with other components which constitute an ecosystem. As such, we have parted from the more traditional concept. Some of the recognition criteria used for two of the map units are provided in Table C1. As the table suggests, ecoregions themselves or the map units of them are intended to represent a terrestrial ecosystem.

Although the component framework of an ecosystem is outlined, it is incomplete unless the relationships existing among its components are treated. Table C1 is only structured as it is for convenience of listing components. This is not to suggest that relationships in the sense of inter, intra, and transrelationships are of little concern. They are to the contrary vital. Besides attempting to account for internal ties, ties between adjacent ecosystems, or ties between distant units, we are also interested in documenting time, process, and systems relationships. Examples of the latter would be:

Time – plant succession, hydrological regime, monthly temperature, precipitation changes, etc.

Process – cyroturbation, gelifluction, podzolization, etc.

Systems – (how one system's integrity is maintained or restricted by another's) influent streams maintaining a wetland, cold air drainage from mountains maintaining plant communities which are cold-tolerant, mountains barring the penetration of weather fronts, etc.

Much of this will be highlighted in the individual ecoregion descriptions which follow.

Table C1: Recognition criteria used for the Northern Coastal Plain and Northern Mountains ecoregions

	Ecoregion Map Units	
Factors	Northern Coastal Plain	Northern Mountains
Landform	Coastal seaboard plain	High fold mountains
Relief	130 m	300 m
Slope	Simple, gentle, and long	Complex, steep, and short
Materials	Glacial drift, fluvial, organic	Colluvium, bedrock, residuum
Vegetation	Arctic tundra - continuous cover - sedge tussocks with understory of trailing shrubs and heath	Arctic tundra and alpine tundra - arctic tundra similar to coast except shrubs and heath are low to medium in height, often paralleling if not superseding the sedges in height - alpine tundra cover is discontinuous and sparse, lichens and forbs predominate
Climate	Polar maritime - fogs and intrusion of cool sea air are important	Polar continental - inversions, aspect, temperature, and moisture lapse rates are important
Soils	Cryosols - gleyed, regosols, and fibric organics types - organic buildup - low depth of thaw, frost polygons common	Cryosols - cumulic regosols, orthic regosols, and some gleyed - decay often equals or exceeds organic accumulation - medium depth of thaw
Hydrology	- perched and near surface water tables; waterlogged depressions; poor drainage often beaded - incised streams or meandering underfit streams	- downslope seepage flow - braided rivers and entrenched beds
Fauna	- pre-calving area for caribou - home range for arctic fox - moulting, breeding, and staging area for waterfowl - polar bear range	- calving area for caribou - home range for grizzly bear and Dall sheep - prime nesting area for raptors

1. NORTHERN COASTAL PLAIN ECOREGION

This is the most northerly of the four ecoregions. It coincides in most respects with what is commonly referred to as the 'Arctic Slope' or the 'Coastal Seaboard Plain'. Topographically, it is a gently bevelled surface. The plain averages 20 km in width and slopes from a high point of 150 m above sea level northwards to the Beaufort seacoast. This irregular-shaped belt of low-lying terrain stretches lengthwise for approximately 200 km, starting from the northeastern tip of Alaska and extending to the northwestern tip of the Northwest Territories. Prominent landmarks are absent. Sheltered locales are rare and largely confined to the vicinities of rivers or streams. The polar continental climate often introduces cold air and fog thereby increasing the effective moisture budget and decreasing the net radiation budget.

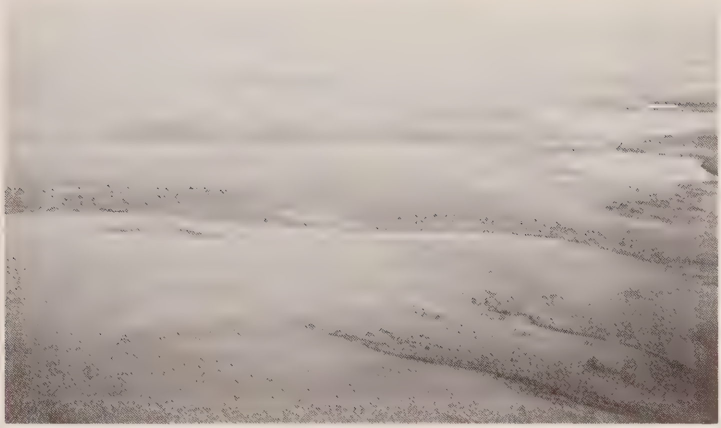
Along this smooth plain, the surficial materials have mixed origins, being derived from glacial and non-glacial processes. While bedrock exposures are very limited in occurrence, moraines and lacustrine and fluvial deposits are common. Their distribution is distinctive and two divisions of the plain can be recognized. Recent fluvial deposits, still in the process of formation, predominate on the plain west of Herschel Island. From a more detailed perspective, this plain is gentler and more regular than its counterpart to the east. The fluvial deposits which form this area consist of extensive braided deltas and prominent inactive and active river channels. Much of the transported material emanates from the Firth and Malcolm river systems. East of Herschel Island, the plain consists of rolling deposits of moraine interspersed with nearly flat areas of lacustrine materials. The two form a mosaic in which the moraine is dominant, especially towards the southern limits. Lacustrine deposits occupy topographical lows, and tend to be the collecting points for overload seepage waters. The wetness promotes the growth of mosses and sedges as well as the accumulation of organic debris. Frost wedging is very active in these lows as evidenced by the very visible net-like polygons. Along the coastal fringe of this division, small, round lakes and ponds are typical. Rivers such as the Babbage and the Blow dissect this part of the plain by channels which tend to have meandering paths in underfit stream beds.

The Beaufort Sea influence exerts a strong control over the climate of the coastal plain. The low water temperatures of the sea and the proximity to pack ice maintain generally low summer air temperatures. The inland penetration of this temperature regime is impeded by the foothills of the Northern Mountains Ecoregion. Because cold air holds little moisture, the precipitation is low in all seasons. The cold sea currents in conjunction with onshore winds also generate frequent fogs and occasionally heavy frosts in the summer period. While this ecoregion, like the others, is exposed to continuous daylight for close to four months, much of the insolation or heat energy is not received due to the presence of widespread fog. This also retards evapotranspiration and contributes to the pervading wetness of the soil. The overall cold climate and brief summers are reflected by the kinds of soils and vegetation.

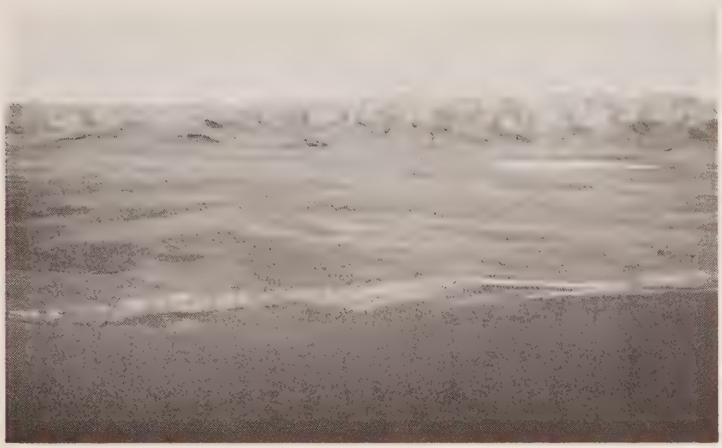
Icy sediments and frozen soils (cryosols) are present. A shallow active layer, resulting from low heat accumulation and insulating effects of organic horizons, coupled with low evapotranspiration potentials, low angle slopes, and fine-textured soil materials, all act to impede surface drainage. Soils are consequently either gleyed or strongly mottled. These wet conditions limit oxygen supply and favour the accumulation of organic debris in surface horizons. In the topographical lows, this is most prominent as water remains at or above the surface for prolonged periods. A variety of wetlands is consequently produced.

Vegetation of this ecoregion may be typified as being arctic tundra and thus trees are absent. The vegetative cover is continuous. In the uplands, it consists primarily of tussocks of cottongrass interspersed with trailing shrubs and heath. Some carices are also present. In the low-lying depressions, sedges and mosses are dominant. The predominance of trailing forms is likely the result of summer frosts, the retardation of plant growth due to the persistence of cold air temperatures, and the character of the soils.

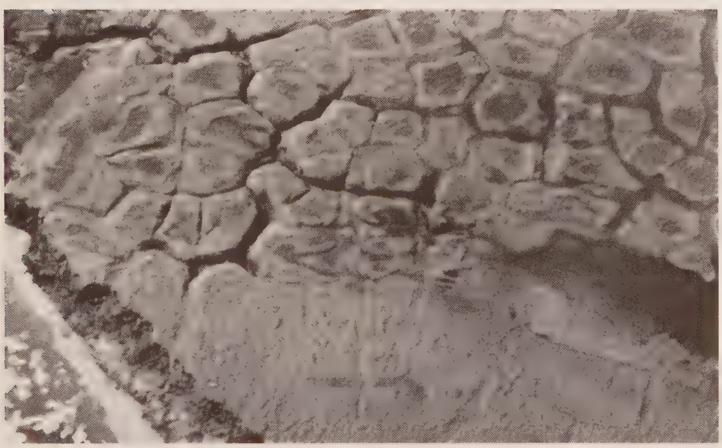
NORTHERN COASTAL PLAIN ECOREGION



a) Sag and swell topography of morainal deposits



b) Fluvial deposits of the Northern Coastal Plain Ecoregion with the Northern Mountains Ecoregion in the background



c) Patterned ground (frost polygons) in fine-textured materials along the coast

2. NORTHERN MOUNTAINS ECOREGION

This ecoregion is an unglaciated mountain barrier separating the Northern Coastal Plain Ecoregion from the more southerly Old Crow Basin Ecoregion. It varies in width from 110 km at the eastern and western extremities to approximately 60 km in the center. High-relief folds are the most typical rock formations.

The nature of the Northern Mountains Ecoregion is unique in comparison with the other three ecoregions. Besides accounting for latitudinal zonation factors, it is affected by altitudinal zonation and to some degree zonation by aspect. As such, it should be considered as a combination of at least two distinct ecoregions which have been expressed as a collective for cartographic or map unit convenience.

The terrain is one of high relief and complex slopes but it can become occasionally hilly. Ridge tops are generally at elevations between 1,000 and 1,600 m and are oriented on a southeasterly axis. The major river valleys, perpendicular to this axis, are associated with the northeasterly flowing Malcolm, Firth, Babbage, and Blow rivers and the southerly flowing Bell and Waters rivers. Valleys of the Babbage and the Blow rivers divide the Northern Mountains into their major physiographic subdivisions: the British Mountains -- a relatively smooth arc composed of parallel ridges; the Barn Range -- a range of widely separated ridges and rounded contours; and the Richardson Mountains -- a mixture of parallel and randomly oriented ridge lines possessing the height and sharpness of the British Mountains. The Barn Range includes denudational mountain types while the others demonstrate structural, tectonic, and constructional forms.

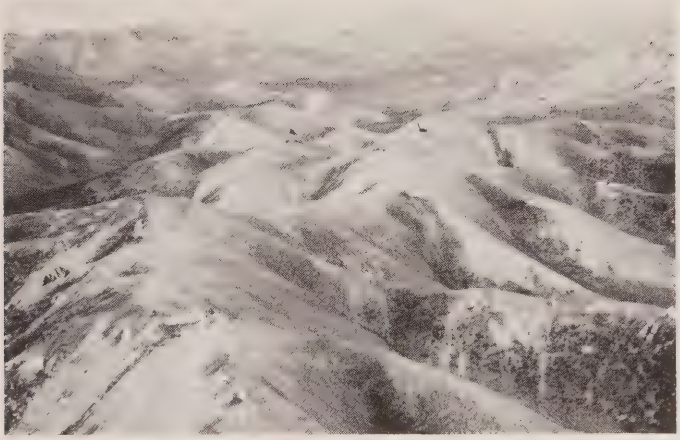
Bedrock exposures are common and are dominated by sandstone, shale, limestone, and dolomite. The rock formations date back to the Precambrian, Carboniferous, Jurassic, and Cretaceous periods. Structurally, they consist largely of simple folds and tilted beds. Other than bedrock, colluvium is also very common. Much of it has resulted from the wearing down of rock through weathering processes. During the Quaternary period, continental ice did not intrude into and erode these mountains. Instead, the frost-prone climate and the fluvial processes have played the major role in sculpturing. Strong seasonal and diurnal patterns of temperature and moderate levels of precipitation have promoted intense frost action. At higher altitudes, the common erosion forms are frost-shattered crags on mountain crests, blockfields on the upper slopes, and radiating colluvial fans and lobate waves of soliflucted material on the upper hillsides. At lower elevations, frost has encouraged turbation and slumping in the unconsolidated surficial deposits, especially where detritus is fairly fine.

Mountain streams of various orders of magnitude and intensity have been the major factors in producing this unconsolidated material which accumulates on the gentler slopes, usually below 600 m elevation. Coalescing fans and pediments are typical depositional forms. The overland waterflow necessary for this fluvial process is assisted by the shallow active layer, the impervious permafrost, the steep gradients, and the denudational effects of frost action on rocks at higher altitudes.

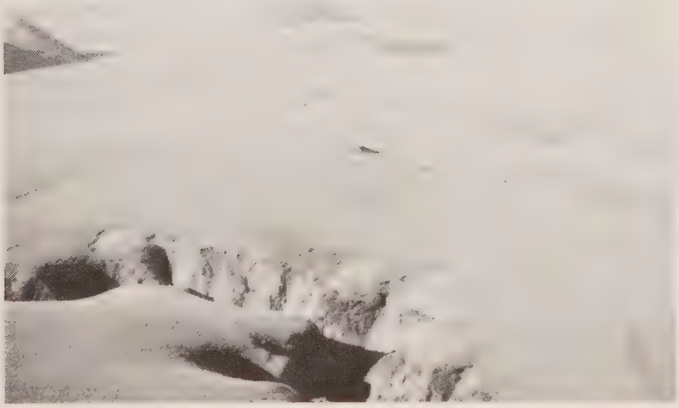
Permafrost is continuous and frozen mineral soils result. Although a few soils are residual -- having developed on bedrock which has weathered in place -- the majority have developed in the colluvial and fluvial deposits. Because the active layer is deeper and slope gradients are steeper than those in the Northern Coastal Plain Ecoregion, mottled or gleyed soils are less pronounced. Also, the deeper ground thaw and infrequent occurrence of organic horizons reflect warmer conditions as compared to the coast.

This ecoregion is largely characterized by a combination of alpine tundra and arctic tundra vegetation. The occurrence of these two types of vegetation is linked mainly to elevation and its associated features. Alpine tundra, usually found above 900 m, consists of sparse and discontinuous vegetative covers, largely of mountain avens and alpine bearberry; crustose lichens are also present. At lower elevations, vegetative ground cover is much more extensive. Here, the plants include a variety of sedges in conjunction with low-to-medium shrubs and heath. Where late-persisting snow patches and cold wet soils occur, the herbaceous plants predominate. Owing to tussocks and hummocks, which occur either alone or in various combinations, the micro topography is markedly rough. White spruce, willow, and, to a lesser extent, balsam poplar are found along protected river floodplains and on mountain slopes having a favourable aspect for heat accumulation.

NORTHERN MOUNTAINS ECOREGION



a) Mountainous terrain



b) Less frequent hilly terrain

c) Pediments of the intermontane areas

3. OLD CROW BASIN ECOREGION

This ecoregion covers the area between the Northern Mountains Ecoregion and the North Ogilvie Mountains Ecoregion. The basin, the largest single expanse of lowland in the study area, is an area of low relief that is approximately 137 km long and 80 km wide. Topographically, this ecoregion can be split into 'flats' and 'pediments'.

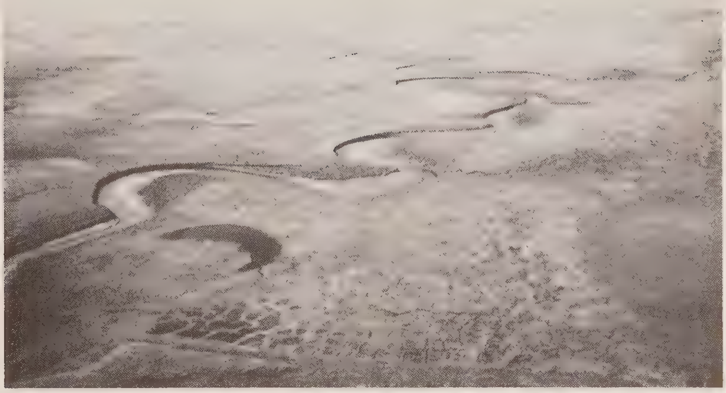
The flats, the most striking aspect of the basin, occupy the western portion at an elevation of approximately 300 m. A substantial part of these flats is comprised of a near-waterscape of shallow, often angular lakes and ponds. Drainage from the lakes and the surrounding areas is southerly. While the headwaters of Thomas, Timber, Black Fox, and Johnson creeks are in the Northern Mountains Ecoregion, their lower reaches meander through the flats and are important elements in maintaining the integrity of the flats. Eventually, they coalesce with the Old Crow River, which bisects the flats and tortuously flows southwards away from the basin proper. The underlying matrix of the flats consists of lacustrine sediments which are often overlaid with a deep organic mantle. The surface expression of this organic terrain takes manifold forms including frost polygons and concentric rings. Permafrost is continuous.

The pediment surfaces encircle the flats in a narrow band, except in the east where they extend for approximately 96 km along part of the southern limits of the study area -- the Porcupine and Bell rivers. Starting at the eastern margin of the flats, this area is comprised of gently undulating pediments which rise over some 30-40 km to an elevation nearing 450 m. Occasionally, these surfaces are overlaid with shallow eolian deposits. In the area beyond the junction of the Porcupine and Bell rivers, the materials are predominantly coarse-textured colluvium. While oxidized soil horizons occur on the pediments, they are much more marked in the colluvial materials. Along with the deeper summer thaw, this soil weathering process indicates a comparatively warmer climate. Low-lying depressions which receive surface runoff waters favour the development of organic soils but their occurrence is not extensive. The larger drainage networks are provided by the Driftwood and Waters rivers and Berry Creek. Their direction of flow and configuration are similar to the rivers and streams in the flats (eg meandering southwards).

The encirclement by mountains directly affects the climate by preventing the easy access of moist air into the basin. In particular, the British Mountains inhibit the penetration of cold arctic air during the summer, and the Old Crow Range and Ogilvie Mountains restrict the penetration of warm south winds in the winter. Consequently, the summers are warm and relatively arid while the winters are prolonged and severe. The warmer summer regime is demonstrated through soil development and is reflected in the vegetation.

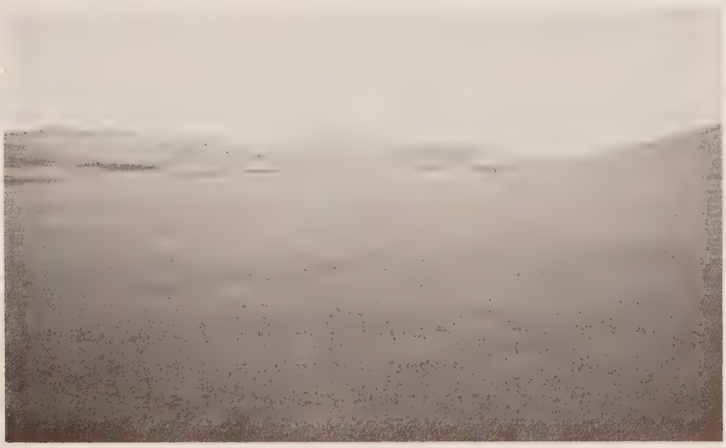
The Old Crow Basin Ecoregion belongs to the tundra-boreal forest transition. Medium and low shrubs and heath and tussocks of sedges are typical of the vegetation cover; these plants grade into open parkland-like stands of white spruce (taiga) in the south and southeast.

OLD CROW BASIN ECOREGION



a) Low relief terrain

b) Meandering rivers



c) Pediments

4. NORTH OGILVIE MOUNTAINS ECOREGION

This is the least extensive of the four ecoregions which extend into the given study area. Because of both its small size and lack of ground truthing, the description of this area is brief.

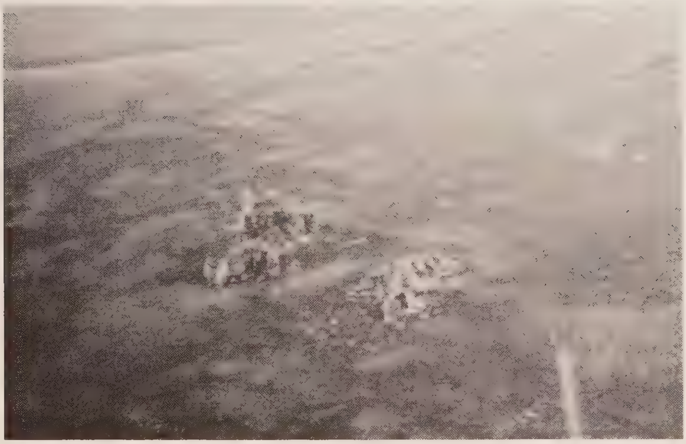
In the southwest corner, the North Ogilvie Mountains Ecoregion is associated with an irregular rectangle 39 km long and 18 km wide. Much of this consists of the subdued granitic formations of the Old Crow Range. From a base elevation of approximately 450 m, these mountains rise from fluvial fans and pediments up along broad valleys covered with colluvial debris to rock-strewn summits. Undulating plateaux are distinctive features of the summit, being demarcated from the mountain slopes by a free-face escarpment near the 900 m contour.

Vegetation is largely of the tundra-boreal forest transition, an ecotone commonly termed 'taiga'. The plants consist of a mixture of intermediate and low shrubs and heaths, various sedges, and open stands of white spruce. Treed areas attain their maximum elevations on southerly aspects owing to greater insolation. An upper limit of 600 m is common on these south-facing slopes. The higher elevations belong primarily to the alpine tundra. Crustose lichens, alpine bearberry, and mountain avens are the principal plants found in the sparse vegetative cover.

Information on soils is lacking. However, reasonable estimates on their properties can be put forward. Permafrost should remain continuous in unconsolidated materials. As the incidence of trees suggests a warmer climate, oxidation of surface soil horizons is likely. Soils are probably fine-textured near the apron of the range, gravelly on the mid-slopes, and rubbly on the summits.

NORTH OGILVIE MOUNTAINS ECOREGION

a) Subdued mountainous terrain



b) Tors and tundra-covered colluvial debris of the Old Crow Range

c) Open stands of white spruce on gentle slopes

SECTION D

ECODISTRICTS

INTRODUCTION

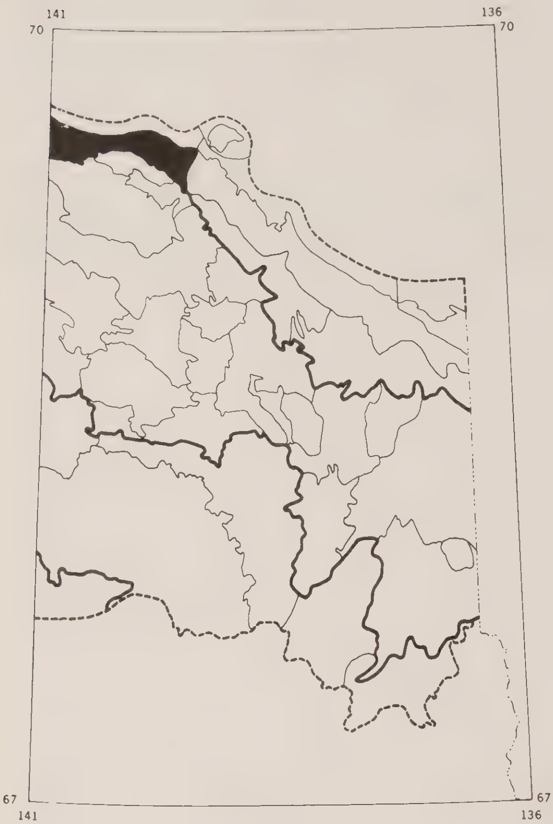
Ecodistricts are the main focus of this study. As subsystems of ecoregions, they are intended to be portrayed on a finer scale. For this study, a map base of 1:500,000 was used. As some reference, ecodistricts coincide with assemblages of such phenomena as: regional landforms, associations of soil subgroups or families, plant districts or associations of major plant communities, the lower range of the meso climatic regimes, and sub-basins or groups of small watersheds.

DESCRIPTIVE NOTES

The following pages provide the descriptions for each of the ecodistricts recognized. They are presented for each of the four ecoregions starting with the Northern Coastal Plain Ecoregion (1) and proceeding southwards through to the North Ogilvie Mountains Ecoregion (4). Within each ecoregion, the ecodistricts are presented in numerical order beginning with the Komakuk Plains Ecodistrict (1.01). A summary of the 33 ecodistricts, their numerical coding, and their ordering under each of the ecoregions are provided in the next section (see Table E1).

While the map legend and criteria will be explained in Section E, the textual descriptions are meant to complement the map. As such, they should be used in conjunction.

1.01 KOMAKUK PLAINS ECODISTRICT



In common with the entire Coastal Plain Ecoregion, the Komakuk Plains are characterized by their low altitude and subdued relief, and their abrupt termination along the foothills and pediments of the Northern Mountains Ecoregion to the south and the Beaufort Sea coast to the north. To the west the Plains continue into Alaska, while eastwards there is a sharp change of geomorphology onto the King Plains Ecodistrict (1.03). This change marks the extreme westward extent of Quaternary glaciation. The Komakuk Plains are an unglaciated land, today covered by extensive fans and braided deltas of rivers originating in the Northern Mountains Ecoregion. In low-lying parts, there is a blanket of patterned organic materials underlaid with marine sediments.

These Plains are plain! Although the ecodistrict slopes from 150 m a.s.l. to sea level from south to north, the local relief is negligible, being a few meters over long, smooth slopes, and over the river banks of the large alluvial fans.

A further distinctive feature of the Komakuk Plains is the presence of aufeis (naleds, or icings) within the ecodistrict, and upstream on some of the rivers flowing into it. The Firth River especially has extensive aufeis upstream, most notably in the Joe Creek (2.05) and Riggs Mountain (2.07) ecodistricts. These icings are indicative of continued groundwater discharge through the water, and moderated discharge and temperature fluctuations during the other seasons. Thus, they are important for water supply as well as for summer migration, spawning, and overwintering of fish.

A number of oriented, rectangular lakes occur in the northwest, straddling the Yukon/Alaska border. Such lakes tend to have depths of less than 3 m, shorelines of organic materials, and an alignment which coincides with the dominant easterly and westerly surface winds. The shoreline consists of low bluffs of rapidly eroding marine sediments. Like the entire northern Yukon coastline, massive ground ice is common in fine and organic sediments, and the melting of this permafrost is a major factor in producing rapid coastal retreat. The nature of the sediments precludes the presence of wide protective beaches. Instead, the silts and clays are deposited offshore, leading to shallow waters and the common grounding of ice floes. Where fluvial deposition occurs, the impact of sediment leads to a protrusion of the coastline, and the larger particles of this sediment become eroded and transported to form prominent bars and spits, most notably the Nunaluk Spit towards Herschel Island (1.02). In the spring, beach sediments commonly contain buried and detached pieces of sea ice. In summer, this ice melts and leaves a curious potholing effect. Foredunes, another curious feature, develop in the beach area, leaving wind-thrown material along the upper edge of the beach escarpment.

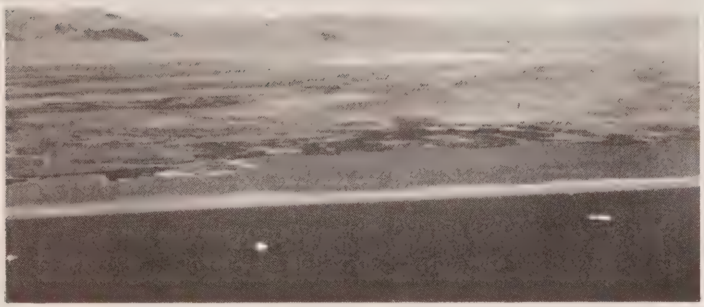
Soils in general are poorly weathered throughout the plains. Much of this results from the shallow depth to continuous permafrost and the presence of free water in the surface active layer for prolonged periods. These soils are characterized as being acid and nutrient poor. Equally, they tend to be rich in organic material since plant material accumulates and little decomposition occurs due to low soil and air temperatures and to the wet and frozen conditions of the ground. Many of these attributes apply as well to the Herschel

Island (1.02) and King Plains (1.03) ecodistricts.

Rivers and streams strongly influence the vegetation of the Komakuk Plains Ecodistrict. Spring floods cover extensive areas, leaving large portions of these deltas bare of vegetation. For the inactive portions of these deltas which are not affected by the spring runoff, vegetation has established and consists predominantly of Carex microchaeta, Eriophorum Scheuchzeri, and other sedges along with scattered trailing and decumbent Salix spp and some Sphagnum spp. Scattered elevated locales of vegetation within this area are characterized by Ledum palustre spp decumbens, Vaccinium vitis-idaea, Betula nana, Aulacomnium turgidum, and other species typical of better-drained sites.

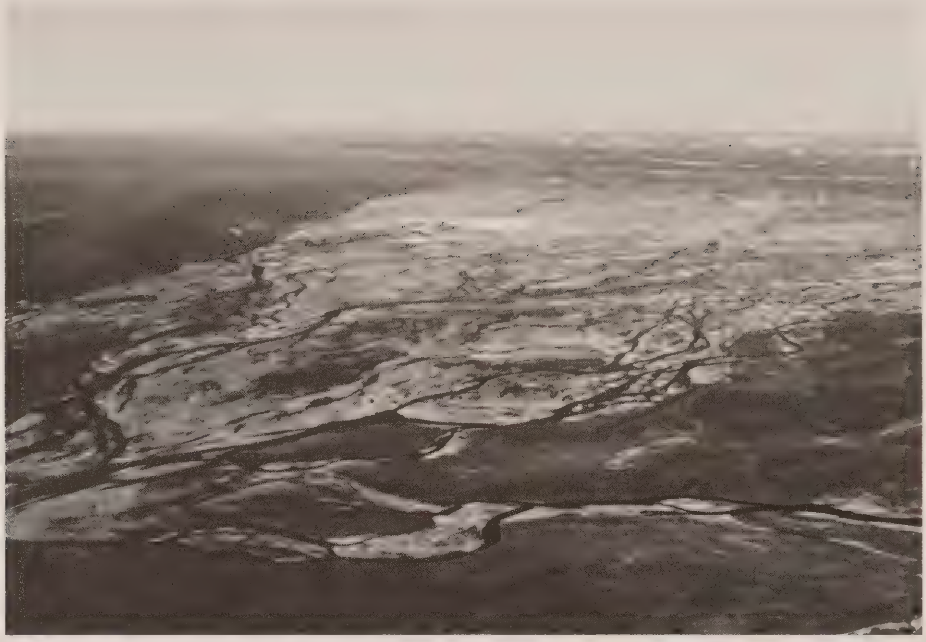
The area between Fish Creek and Clarence Lagoon contains expanses of tussock tundra dominated by Eriophorum vaginatum, and trailing forms of Ledum palustre ssp decumbens, Vaccinium vitis-idaea, Betula nana, and Sphagnum spp.

The organic terrain has vegetation which is peculiar to the type of frost polygon which is present. Low-center polygons, which predominate, have cores covered by sedges and Sphagnum spp along with trailing forms of Ledum palustre ssp decumbens, Andromeda polifolia, Vaccinium vitis-idaea, Salix spp, and Betula nana forming the elevated rims. High-center polygons have tussocks of Eriophorum vaginatum along with Ledum palustre ssp decumbens, Vaccinium vitis-idaea, Betula nana, and Sphagnum spp on the elevated central portions and largely Carex aquatilis and Eriophorum angustifolium in the ice-wedge troughs which form the matrix.



In foreground, one of several expansive deltas, the Firth River delta, within the Komakuk Plains Ecodistrict

Predominantly sedge-covered organic terrain near Komakuk Beach; the Northern Mountains Ecoregion commences with the foothills in the background



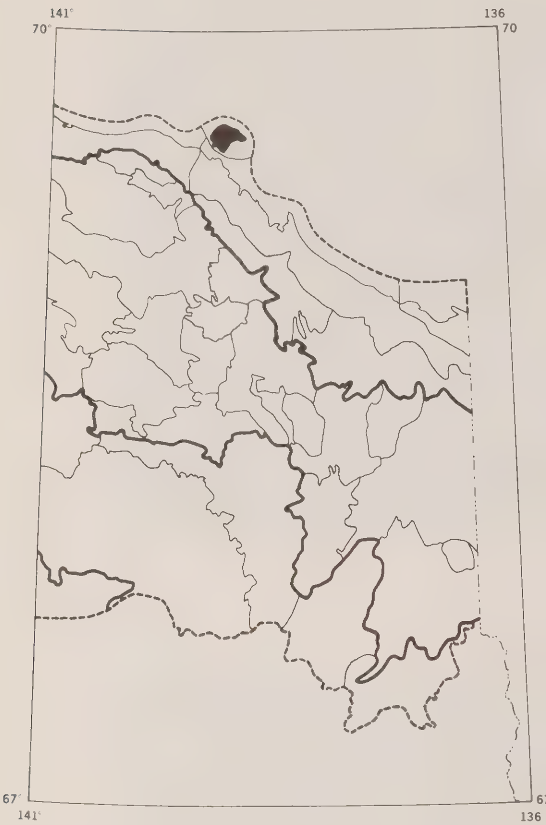
Typical braided delta of the Komakuk Plains Ecodistrict; aufeis on the Firth River delta

Nearly level terrain; a continuous cover of sedges along with trailing willows and some moss is typical on these plains

Narrow beaches, small cliffs, and occasional strandlines along the coast in the Komakuk Plains Ecodistrict; logs, transported from the Mackenzie valley by ocean currents, are a common site along coastal beaches

Coastal beach and cliff features in the Komakuk Plains Ecodistrict; logs litter beach in foreground; high-center polygon terrain (background) is a common feature in the more poorly drained lowlands

1.02 HERSCHEL ISLAND ECODISTRICT



Herschel Island retains a special place in the history of the Canadian north. For many years, it was a prominent whaling port, where vessels would commonly overwinter in the shelter of Thetis Bay. The island shows evidence of Inuit migrations; from 1903 to 1964 it held an R.C.M.P. post. The island shares a glaciated past with the King Plains (1.03), Babbage Plains (1.05), and Running River (1.06) ecodistricts. It is distinguished as an ecodistrict, however, by a relatively high elevation (up to 180 m) compared to the King Plains (1.03) across the water, by the general absence of lakes, by the moderating influences on the surrounding sea and the proximity to ice pack, and by the distinctive gorges and gullies which excavate the plateau surface of the island. These streams cut quickly into the fine-textured, unconsolidated sediments producing extensive bowl-shaped slumps and hence disturbed areas for an enriched flora.

In lithology and long-term origin, Herschel Island is composed of Quaternary marine sediments. Like the similar sediments perched on top of Engigstciak in the Buckland Basin (2.02), these sediments are, curiously, above the maximum Quaternary sea level as inferred from all other northern Yukon areas. The usual explanation is that these marine sediments were excavated by pre-Wisconsin ice advances and emplaced as 'push-moraines'.

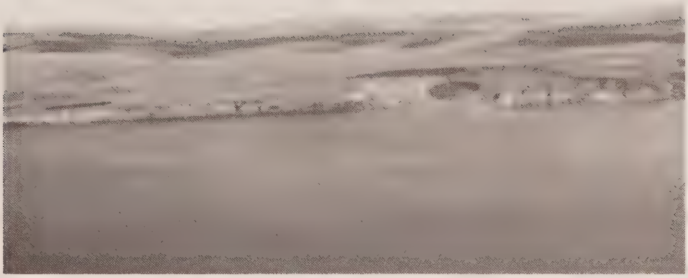
The combination of unconsolidated sediments and relatively high relief produces not only extensive thermokarst slumping but also spectacular erosion of sea cliffs. The slumping activity is most pronounced on the northern coast of the island, whereas cliff retreat is most dramatic on the western coast. In both locations, the massive ice beds (15-30 m) which underlie the marine sediments are frequently exposed. Towards the eastern and southern coasts, the elevation of the plateau is much lower and the extent of mass wasting is less extensive. The interior of the island has drainage networks which show marked erosion and has upland surfaces which display solifluction processes.

Organic soils are not prevalent. Acidic conditions, frozen sediments, shallow active layers, mottled and gleyed profiles, and restricted weathering are attributes associated with the mineral soils.

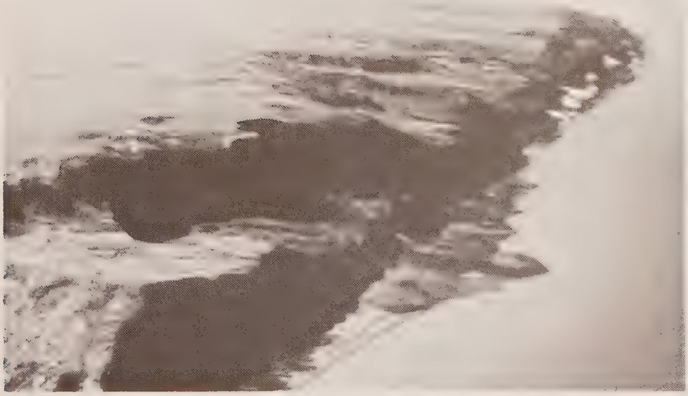
The more elevated, well-drained central portions of the island are covered with expanses of tussock tundra, dominated mainly by _Eriophorum vaginatum_ tussocks, trailing ericaceous shrubs (particularly _Ledum palustre_ and _Vaccinium vitis-idaea_), and various herbs.

Slides and mudflows which have restabilized are characterized by a particularly lush herb flora consisting of _Senecio congestus_, _Tripleurospermum phaeocephalum_, _Lupinus arcticus_, _Myosotis alpestris_, _Pedicularis_ spp, grasses, etc. _Salix reticulata_ and other trailing forms of _Salix_ spp are also prevalent. Solifluction slopes also support a wide variety of herbs. Exposed mineral soil is prevalent in areas of recent and stabilized movements, in solifluction areas, and in patches scattered throughout the slopes of the island.

Drainage channels contain low and decumbent _Salix_ spp, _Ranunculus_ spp, and a variety of other herbs.



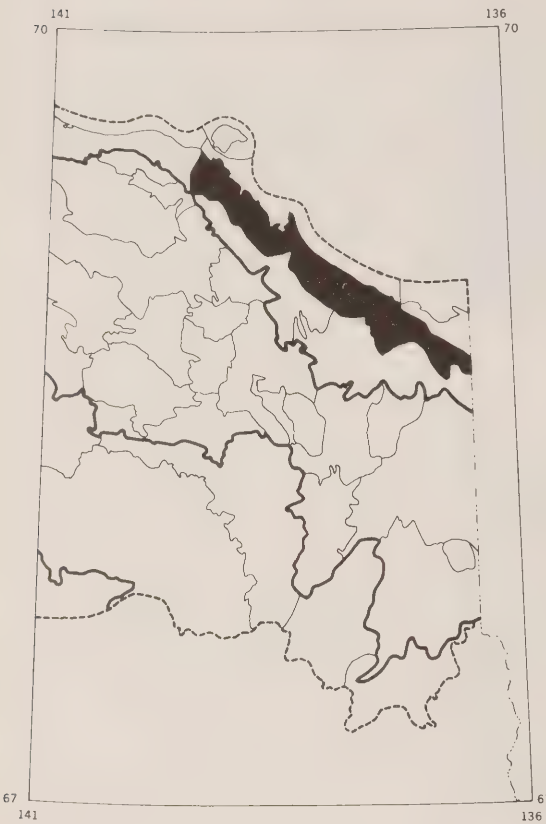
East side of Herschel Island showing active slumping along the coastal margin



Cliffs along the northeast coast of Herschel Island; beaches are typically narrow due to active longshore transport of sediment

Lush vegetative cover of a large, stabilized slump and flow area

1.03 KING PLAINS ECODISTRICT



The King Plains are part of the glaciated lowlands of the Northern Coastal Plain Ecoregion. Physically, the King Plains Ecodistrict differs from the Babbage Plains (1.05) and Running River (1.06) ecodistricts mainly by virtue of its many lakes, especially east of the Babbage River, and by the presence of massive ground ice and icy sediments. Ground ice commonly occurs down to 8 m depth, and occasionally to 25 m. Any disturbance of these locations can lead to thermokarst conditions. The abundant lakes and massive ground ice correspond closely to the Wisconsin-glaciated areas east of Kay Point. While the lakes may be characteristic of stagnant-ice moraine, a thermokarst origin is equally probable. The coincidence of ground ice and glacial chronology lends support to the notion that the ice is residual from that time; in the pre-Wisconsin glaciated areas farther to the south, much of the ice has gone, and fluvial, colluvial, and organic materials present have had longer to reduce the percentage of lake cover.

In general the King Plains are a glacially deposited plain with numerous swells and swales. The plain rises from near sea level in the west to a 150 m scarp overlooking the Mackenzie Delta (Shoalwater Bay 1.04) in the east.

The typical arrangement of materials is to have frost-wedged organic materials overlying lacustrine and fluvial materials in the depressions; till or, to a lesser extent, deformed marine and fluvial sediments occupy the elevated and more commonly occurring protuberances.

The drainage of this ecodistrict is by small wetland streams, often beaded, which merge to become small, meandering creeks. Flow is maintained by groundwater seepage from the glacial sediments, by snowmelt, and by slow release of water stored in lakes. In winter, these streams either dry up completely or freeze solid. The lakes of the King Plains are highly variable in size, so that an expression of average size is almost meaningless. Sizes range from puddles and ponds to over 100 ha.

Several larger rivers cross the ecodistrict, notably the Spring, Babbage, Running, and Blow rivers and Rapid Creek. They are all meandering to anastomosing rivers, becoming progressively more incised eastwards. Flows are highly seasonal, reflecting precipitation trends in the Northern Mountains Ecoregion. In summer these are wide, shallow, gravel-bed rivers with many islands.

The coastline of the King Plains consists of unconsolidated sediments; bedrock outcrops have not been recorded. The shoreline is of high bluffs which are retreating at rates of 1.5 to 5.0 m per year, and yet which produce little beach material. Much sediment is transported by longshore drift to Kay Point or to Shoalwater Bay; only narrow gravel beaches remain. Any large-scale removal of these gravels could exacerbate cliff retreat, as the refurbishing of protective beaches appears to be slow.

Coastal landforms include both gullied cliffs and large block-dumping/mudflow sections. The latter are commonly associated with melting massive ground ice. These are spectacular features, often with overhanging soil/vegetation mats, glistening walls of ice,

and interslump sections which provide easy foot travel down to the beaches.

Like the soils of other ecodistricts within this ecoregion, the King Plains soils are not mature and remain in equilibrium with their environment. The mineral soils are ice-rich, acid, mottled, and frequently gleyed. The active layer remains near to the ground surface and plant nutrients are limited. The organic areas are composed mainly of fibrous plant materials. These organics are waterlogged; the permafrost contact is shallow.

The moraine of the King Plains Ecodistrict is predominately tussock and trailing heath tundra composed of Eriophorum vaginatum along with Ledum palustre ssp decumbens, Vaccinium vitis-idaea, and Betula nana. Other trailing shrubs such as Vaccinium uliginosum, Empetrum nigrum, Cassiope tetragona, and Andromeda polifolia are widespread, and mosses, particularly Sphagnum spp or Aulacomnium spp, are locally abundant. Cetraria cucullata, C. nivalis, Thamnolia vermicularis, Alectoria ochroleuca, Dactylina arctica, Cladina spp, and other ground lichens are ubiquitous though rarely abundant.

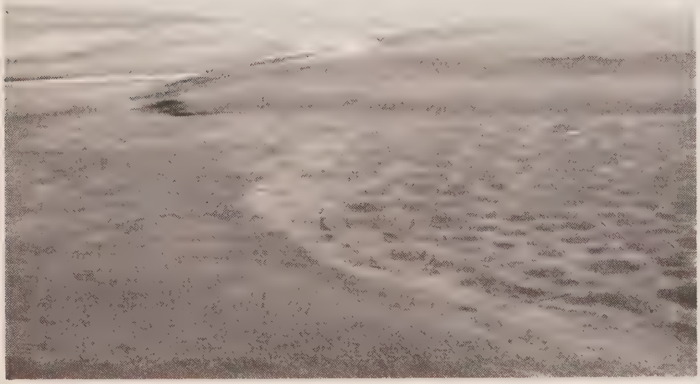
Patterned ground is largely associated with the wetlands. Low-center polygons are most abundant; they are covered by sedges and Sphagnum spp in the depressed central portions and by Sphagnum spp, Vaccinium vitis-idaea, Andromeda polifolia, Ledum palustre ssp decumbens, and Betula nana on the elevated rims. High-center polygons have Vaccinium vitis-idaea, Ledum palustre ssp decumbens, Betula nana, Eriophorum vaginatum, Rubus chamaemorus, and Dicranum spp in the elevated central portions and Carex aquatilis, Eriophorum angustifolium, Betula glandulosa, Rubus chamaemorus, and Sphagnum spp in the ice-wedge troughs.

The shallower portions of most of the numerous lakes and ponds of the ecodistrict support populations of Potentilla palustris, Carex aquatilis, other sedges, Hippuris vulgaris, etc. Low Salix spp are common around lake and pond perimeters.

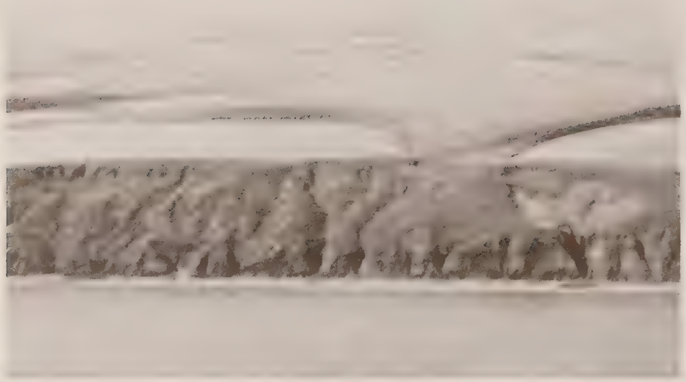
Small streams and drainageways support communities of Salix pulchra, S. glauca, other Salix spp, and Betula glandulosa along with a variety of herbs including Petasites frigidus, Viola epipsila, Aconitum delphinifolium, and Ranunculus spp.

Rivers and streams having coarse-textured floodplains, such as the Blow and Running rivers, support thickets of Salix alaxensis, which often attain heights of 2-4 m. They indicate the warmer site conditions which prevail in these localized areas. Thickets of other Salix spp, usually under 1 m in height, are also abundant in these floodplains, along with Lupinus arcticus, Douglasia ochotensis, Epilobium latifolium, and other herbs. Thickets of Alnus crispa are widespread on slopes above streams and rivers and Arctostaphylos alpina, Betula glandulosa, Vaccinium uliginosum, and Lupinus arcticus are common at the tops of slopes. Here, however, the low and trailing forms return.

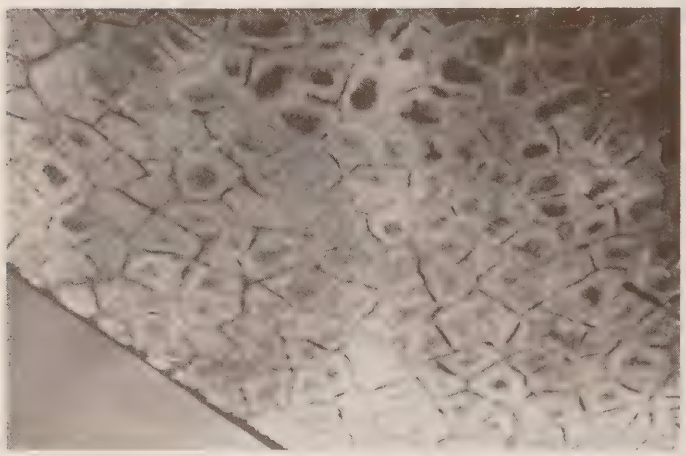
Sedge meadows are common in areas of restricted drainage, particularly where surface water persists, and are dominated by Carex aquatilis, Eriophorum angustifolium, other sedges, and Salix spp.



Typical relationship of morainal hills covered with tussocky cottongrass-heath interspersed with polygonal organic lows dominated by sedges and mosses



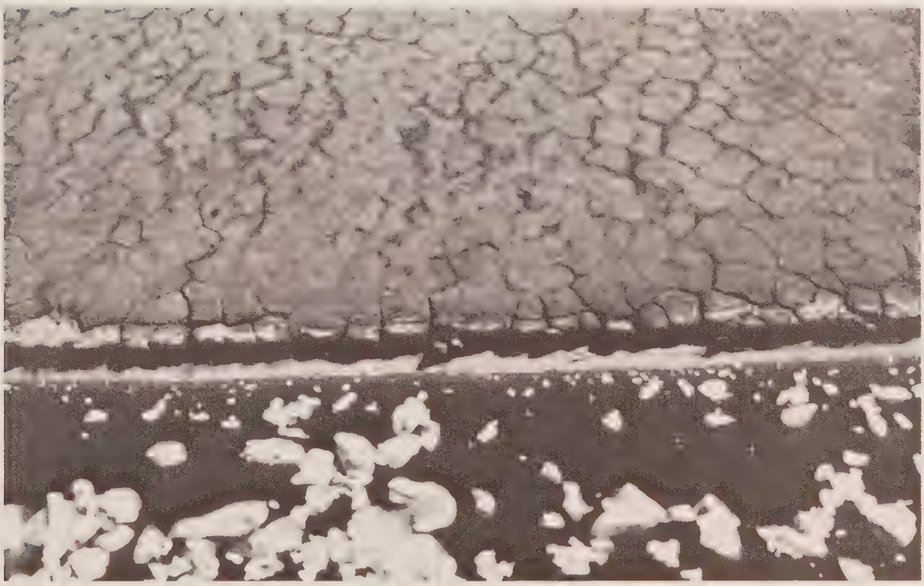
Lakes that are typical of the King Plains; coastal cliffs and narrow beaches along the turbid waters of the Beaufort Sea in the foreground



Patterned ground (low- and high-center polygons) along the coastal fringe in the King Plains Ecodistrict; turbid waters of the Beaufort Sea in the bottom left

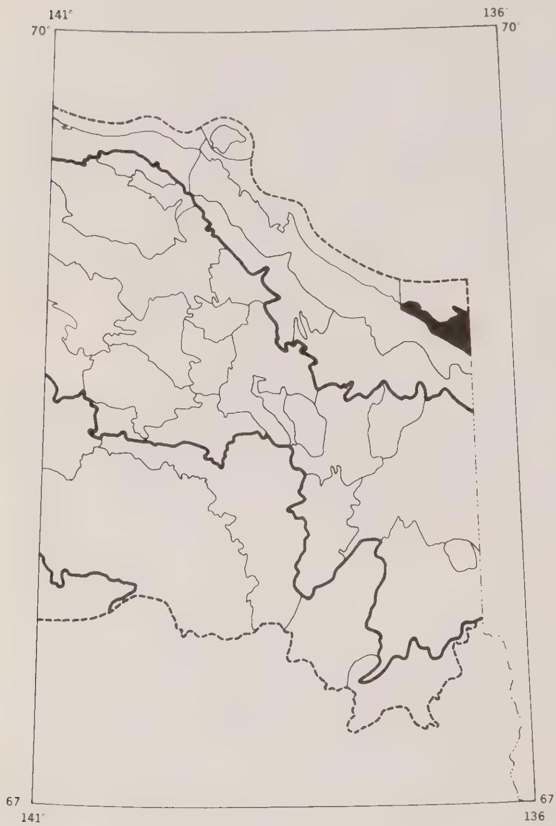
Tussock-trailing heath (sheathed cottongrass-Labrador tea-bog cranberry) and lichen community typical of moraine sites in the King Plains Ecodistrict

Area of strandlines (raised beaches)



Patterned ground (high-center polygons) along the coastal margin; low cliffs (formed by thermal erosion) and narrow beach; wind-blown sandy beach materials along the margin of the cliffs

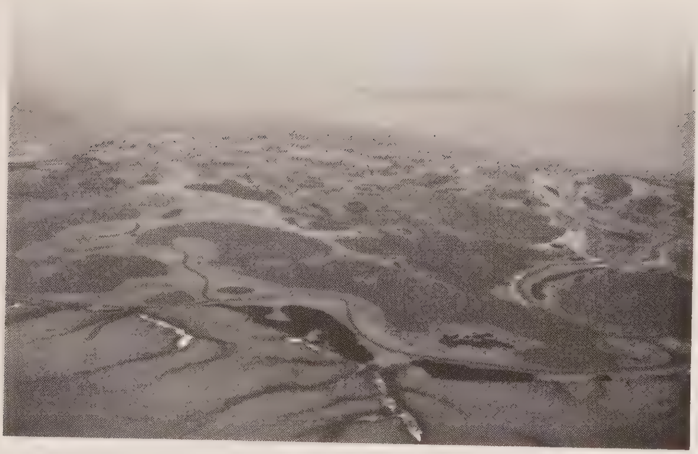
1.04 SHOALWATER BAY ECODISTRICT



The Shoalwater Bay Ecodistrict might be best described as a waterscape. It is part of the modern delta of the Mackenzie River and, within the northern Yukon study area, is second only to the Old Crow Flats (3.02). The Old Crow Flats are composed mostly of lacustrine sediments covered by an organic blanket, whereas the Shoalwater Bay landscape combines organics with a variety of river-borne detritus, from gravel to silt to driftwood. The Mackenzie River's Moose Channel meanders through much of this area, while in the western portion, Rapid Creek flows from the mountains to the south, to build its own small delta at Trent Bay.

Because the geomorphic surface is young, the soils are not developed. In many places of the delta, the mineral surface is on a yearly basis either eroded of materials or covered with a veneer of new sediments. The type of spring runoff in the Mackenzie River system determines much of this. Since open bodies of water are common and the relief of the land surface is minimal, the soils are not well-drained. Some organic terrain is also present.

Despite heavy annual spring flooding, most of the land surface has a complete vegetative cover. Low willows are prevalent along channels and around lakes and much of the lower portions of the terrain contains sedge meadows, with Carex spp as the dominant cover.

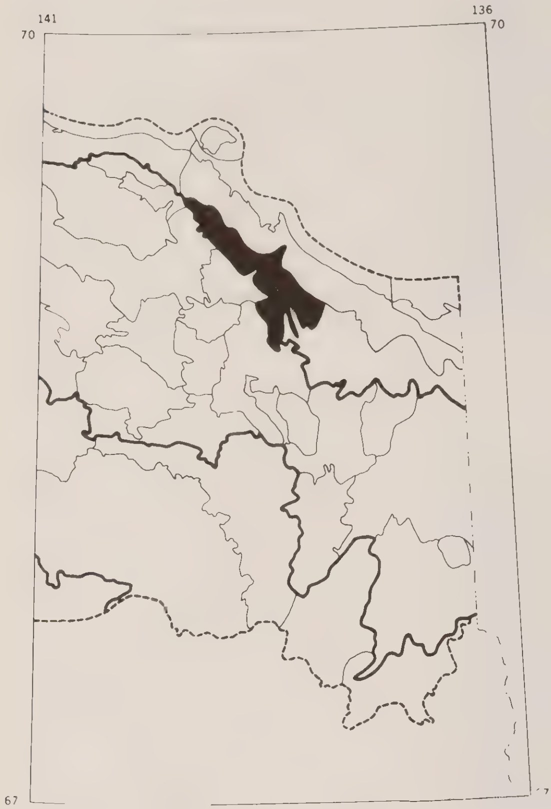


Embayments, bays, and lakes are common in the Shoalwater Bay Ecodistrict

Typical meanders and broad floodplains

Lake- and pond-dotted lowlands

1.05 BABBAGE PLAINS ECODISTRICT



Like the Running River (1.06) Ecodistrict, a glance at the topographic maps shows that the Babbage Plains Ecodistrict extends inland to an elevational contour of about 150 m. From its seaward side, the ground climbs gradually upwards from the lake-studded King Plains to the pediments and passes of the Tulugaq Pediments (2.15) and Blackfold Hills (2.12) ecodistricts. Here the boundary is clear, especially on aerial photographs and on the ground; the line generally marks the limit of Quaternary glaciation.

In the west, against the British Mountains (2.04), this particular boundary is strongly marked by deeply incised spillway channels, now occupied by a string of small, elongated lakes. Covering fluvial sediments along the streams are also found. Streams of local origin are mainly of seepage flows on the organic covers; most well-defined channels on the Babbage Plains are incised streams and rivers crossing from the Northern Mountains to the south. In common with most rivers of the northern Yukon, flows are highly seasonal, headwaters flowing only during the short spring melt season. They are mainly braided to anastomosing channels, except the Babbage which is a normal meandering stream.

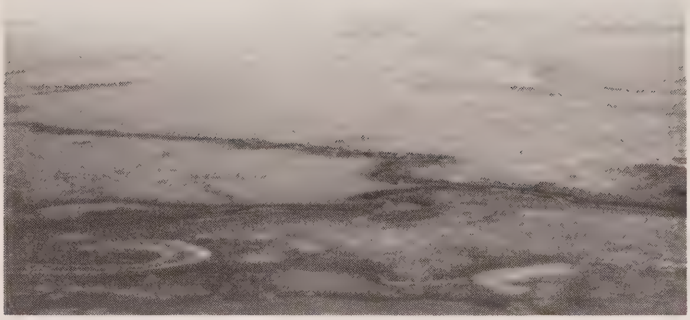
There are few lakes in the Babbage Plains. This area is one of pre-Wisconsin glaciation, and the absence of lakes as compared to the Wisconsinian King Plains (1.03) reflects the longer period for the melting of ground ice and the reduction of topographic irregularities.

The Babbage River has aufeis in its headwaters in the Cottonwood Creek Ecodistrict (2.13); Roland Creek has one small icing present within the area. These icings moderate discharge and temperatures, and so these rivers may be expected to provide more-favoured habitats for both vegetation and wildlife.

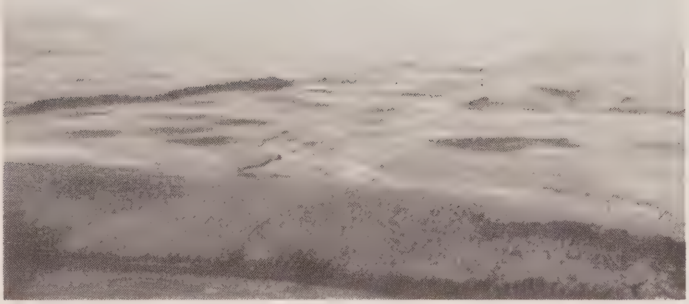
The soils of this ecodistrict are much akin to those in the Running River Ecodistrict (1.06). In terms of soil development, these soils are not appreciably weathered. The mineral soils are fine-textured and permafrost remains close to the surface. The mineral soils also typically possess mottled profiles indicating the fluctuating free water in the active layer. Fibrous organic soils are associated with the patterned ground of the fens. Because of the near-surface permafrost and the overland seepage from the surrounding swales of moraine, these swales have a perched water table on or near the surface for prolonged periods throughout the summer.

The Babbage Plains Ecodistrict consists of extensive areas of tussock/trailing heath tundra characterized by <u>Eriophorum vaginatum</u> along with <u>Ledum palustre</u> ssp <u>decumbens</u>, <u>Vaccinium vitis-idaea</u>, <u>Betula nana</u>, and decumbent or low <u>Salix</u> spp; <u>Sphagnum</u> spp is locally abundant. Sedge/moss fens occur. Their structure, composition, and floristics are similar to those fens which are described for the King Plains Ecodistrict (1.03).

Rivers with gravel floodplains contain thickets of <u>Salix alaxensis</u>, occasionally exceeding 3 m in height, along with thickets of other <u>Salix</u> spp. Other stream and river valleys have thickets of <u>Salix pulchra</u>, <u>S. glauca</u>, and other <u>Salix</u> spp, along with a variety of herbs including <u>Petasites frigidus</u> and <u>Rubus chamaemorus</u>.

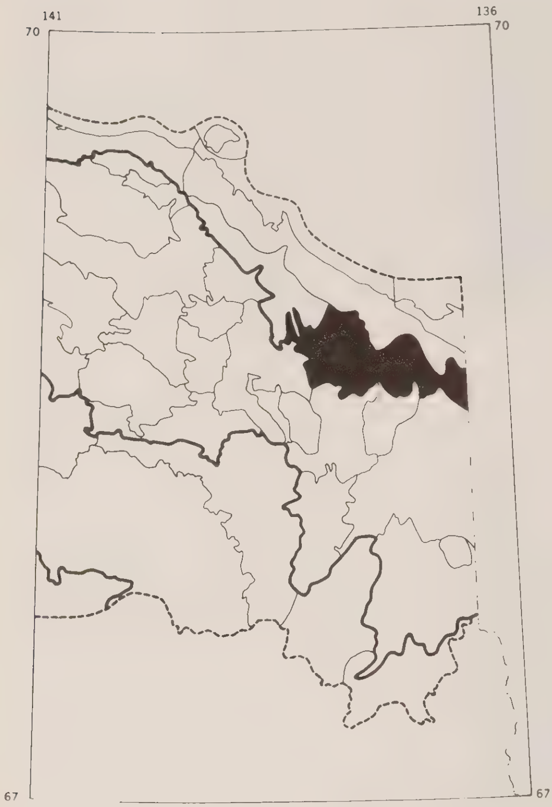


Portion of the tundra covered, low, gently rolling plain near Shale Creek



Underfit Babbage River and remnant river terraces

1.06 RUNNING RIVER ECODISTRICT

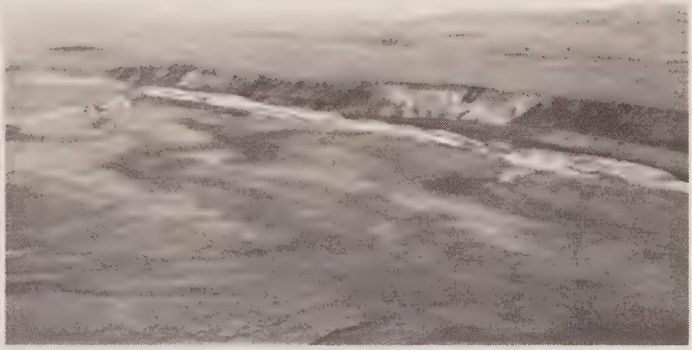


The Running River Ecodistrict is an eastern counterpart to the Babbage Plains Ecodistrict (1.05). Both are sharply demarcated to the north by the pitted Wisconsin moraine of the King Plains. However, the Running River Ecodistrict is more elevated than the Babbage Plains; the change in the south to mountains is more precise, and, most importantly, low bedrock hills commonly rise through the moraine to produce areas of residual and colluvial materials and lend character to the form of the overlying moraine and recent organic accumulations. Despite these bedrock features fluvial deposits in broad, incised, anastomosing and braided rivers are more extensive, so that dominant materials are moraine, organic, and fluvial. Some lakes and lacustrine materials occur in depressions towards the King Plains (1.03) border: here patterned ground can again be seen.

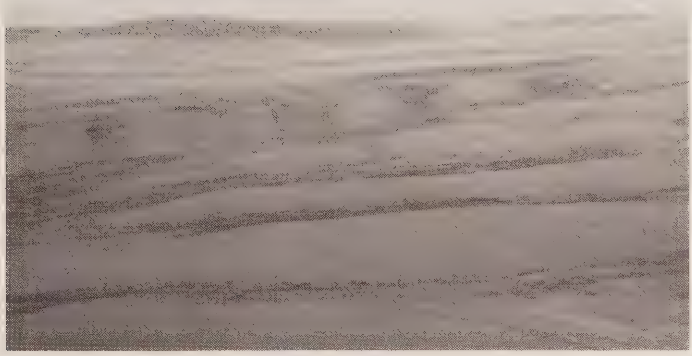
The Running River Ecodistrict is largely tussock/trailing heath tundra typically composed of Eriophorum vaginatum along with Ledum palustre ssp decumbens, Betula nana, Salix spp, Vaccinium vitis-idaea, and Sphagnum spp.

From the air, the ecodistrict has a prominent mottled appearance due to the contrast between the yellow-brown of the tussock/trailing heath tundra and the dark greens of the numerous rivers and countless drainageways which finely dissect it. Salix pulchra, S. glauca, and other Salix spp, ranging from 15 cm to 1 m in height, are prevalent in the river and stream valley bottoms, in the drainageways, and on slopes throughout the ecodistrict. Rivers and streams with coarse-textured floodplains support thickets of Salix alaxensis, along with other Salix spp and a variety of herbs including Lupinus arcticus and Epilobium latifolium. The well-drained, coarse-textured materials which are associated with the bedrock hills above the floodplains are characterized by Arctostaphylos alpina, Dryas octopetala, and Saxifraga tricuspidata.

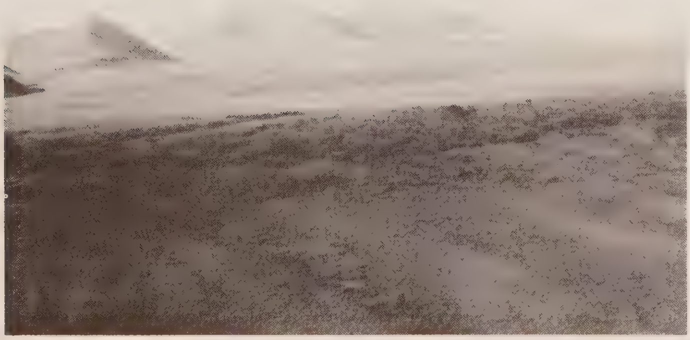
The patterned organic swales of these plains are sedge-moss fens. Again the description given for the wetlands of the King Plains Ecodistrict (1.03) is generally applicable to organic areas.



Gently rolling morainal plains in the Running River Ecodistrict; rock outcrops and hills are occasional occurrences

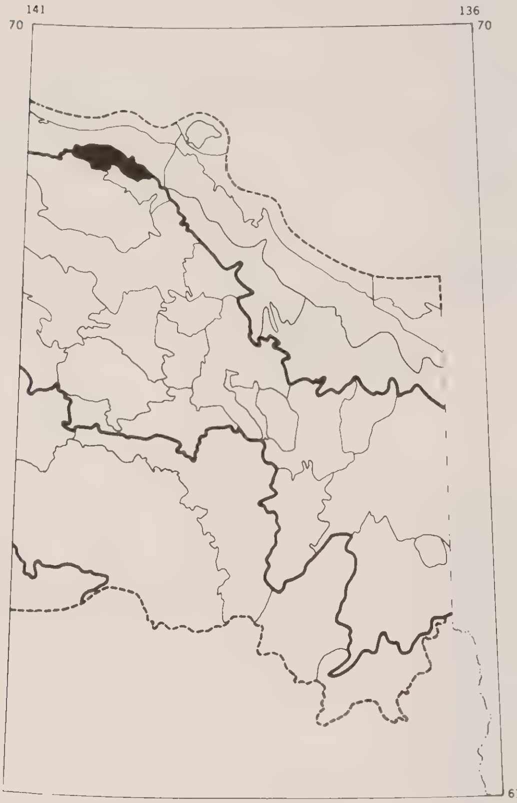


Tundra-covered plains of the Running River Ecodistrict



View south over gently rolling morainal plains; low bedrock hills of the Northern Mountains Ecoregion in the background

2.01 MOUNT CONYBEARE ECODISTRICT



This ecodistrict is a range of foothills of the Northern Mountains. It is set apart from the Malcolm River (2.03) and British Mountains (2.04) ecodistricts by the lowland pediments of the Buckland Basin (2.02) and a broadening of valleys at the southwest end of the Mount Conybeare Ecodistrict. Along the northern edge, this ecodistrict terminates abruptly against the Komakuk Plains (1.01). Although the area has a low average elevation compared to the rest of the Northern Mountains, a couple of prominent peaks, 585 m and 628 m (Mt. Conybeare itself), lend a high local relief. This is the only ecodistrict in the northern Yukon in which the local relief value exceeds the average elevation.

The Mount Conybeare hills are treeless, rounded hills on which colluvial material dominates. Talus and solifluction slopes abound, merging downhill into fans and aprons, with the deposits of gravel-bed streams in the valley floors. Like all headwater streams in the northern Yukon, these are irregular channels which flow mainly in the spring but which can nevertheless transport boulder-size material. Floodplains are consequently composed of gravels with sandy matrices. A consequence of their variable flow characteristics is that during summer field seasons these streams assume a braided to anastomosing form with often 90% or more of the channel bed left high and dry. Thus summer navigation, even by canoe, is impossible on all but the major rivers of the northern Yukon.

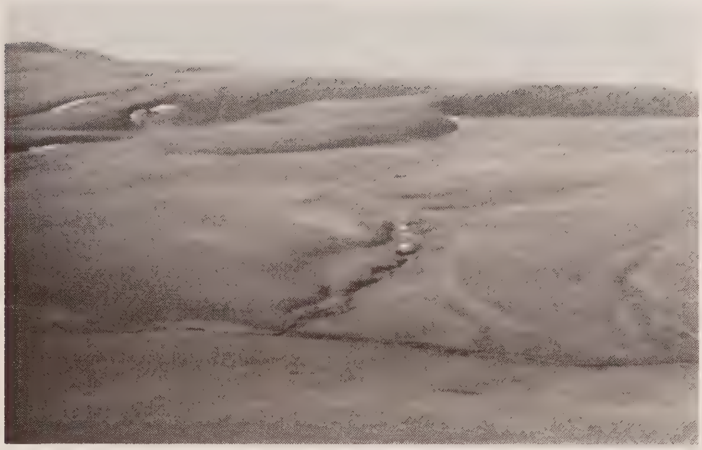
A distinctive feature of visual appeal in this ecodistrict is the presence of numerous bedrock crags. Equally, on the mid-slopes of the talus debris, hoodoo-like tors protrude and appear to be standing like sentries. Such bedrock structures often provide suitable perching and nesting habitat for raptors.

The dominant characteristics of the soils are that they are subject primarily to frost-shattering on the upper portions of the hills and to solifluction on the lower portions. While permafrost is still continuous, the average depth of the active layer exceeds that recorded for soils in the Northern Coastal Plain Ecoregion, often in the range of 30 to 60 cm. Non-sorted circles and nets are typical of the unvegetated or poorly vegetated crests; on mid and lower slopes, however, non-sorted nets and stripes commonly develop. With the better drainage, the deeper active layers, and the warmer, wetter climate, these soils start to show evidence of an oxidized layer of the soil profile.

Although the crests of these foothills generally lack vegetation, the upper slopes and mid slopes support discontinuous covers composed mainly of Dryas octopetala along with Saxifraga tricuspidata, other Saxifraga spp, Arctostaphylos alpina, decumbent Salix spp, and Hierochloe alpina. Surface rock fragments often have high covers of Rhizocarpon geographicum and other crustose lichens. Overall, the vegetation of these rocky and alpine barrens is poorly developed.

Pediments are covered predominantly by tussock/dwarf heath tundra characterized by Eriophorum vaginatum along with Ledum palustre ssp decumbens, Vaccinium vitis-idaea, and Betula nana. Drainageways within the tussock tundra are mainly covered with Salix pulchra, S. glauca,

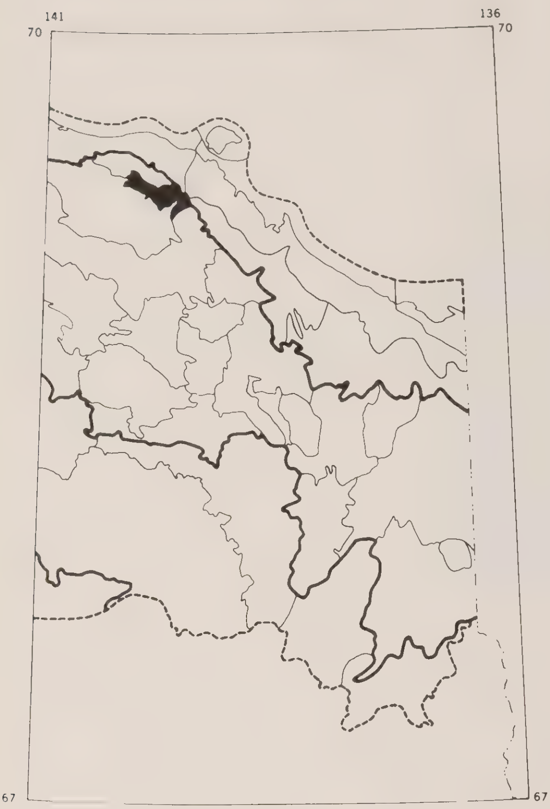
S. reticulata, and other Salix spp or Carex spp. River or stream valleys also contain Salix spp and Carex spp along with a variety of herbs.



Rounded hills mantled with colluvial debris and frost-shattered bedrock

Sparsely vegetated upper slopes and continuously vegetated lower slopes typify the Mount Conybeare Ecodistrict

2.02 BUCKLAND BASIN ECODISTRICT



The Buckland Basin is essentially a single, broad valley of pediment surfaces. It separates the eastern end of the hills of the Mount Conybeare Ecodistrict (2.01) from the Malcolm River (2.03) mountains. The pediments present smooth, gently sloping surfaces of tussock tundra which are drained by wetland-type streams, occasionally growing to become gravel-bed types before entering the Firth or Malcolm rivers, the two major streams that cross this ecodistrict.

The Buckland Basin sections of the Malcolm and Firth are of large, braided-channel types which have aufeis within the basin or upstream. It is unknown whether reliable, year-round flow occurs ever in these large rivers. The Water Survey of Canada maintains a gauging station on the Firth River in this ecodistrict. Records cease from January to May inclusive, and zero discharges are noted in December and June. Some flow may occur through the river bed gravels, however, or the zero discharges may be an artifact of the gauge location or river ice conditions.

At the eastern end of the basin is Engigstciak, a small hill rising from the Firth River floodplain. The distinctive, asymmetric shape with a cliff at one end, and its strategic and view-commanding position over the Firth River, Buckland Basin (2.02), King Plains (1.03), and Babbage Plains (1.05), have given this hill a prime archaeological significance. Nine cultures of nomadic hunters have used the hill for spotting and killing game; bones found include caribou, bison, horse, and wapiti.

The hill has a bedrock core and a capping of ice-emplaced marine sediments. On a micro scale, it resembles a cuesta. Like Herschel Island, it marks the extreme movement of Quaternary ice along the Northern Coastal Plain.

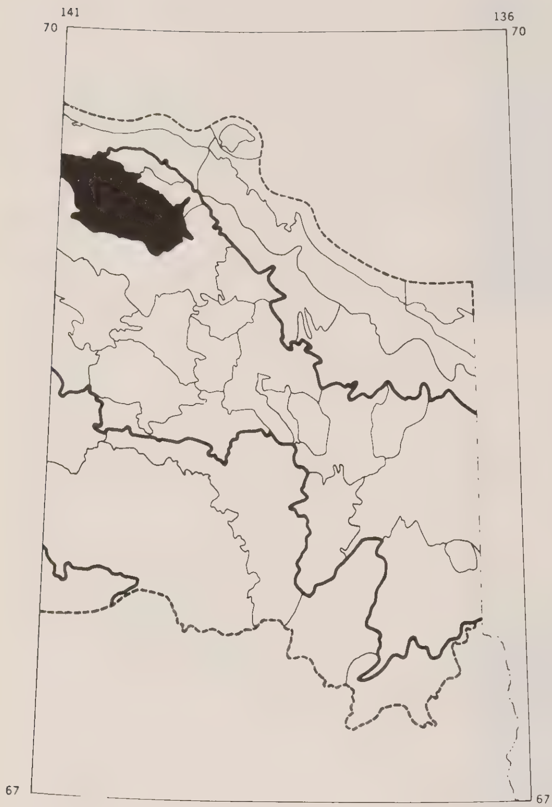
Soils are fine-textured; near-surface permafrost conditions occur. The deeper active layers coincide with the higher forms of vegetation. While they are limited in extent, this vegetation also corresponds to the drainage lineations.

The Buckland Basin Ecodistrict is largely tussock/dwarf heath tundra characterized by Eriophorum vaginatum along with Ledum palustre ssp decumbens, Vaccinium vitis-idaea, and Betula nana. Salix spp and Betula glandulosa are prevalent on the lower portions of slopes and in the downslope portions of drainageways. Upslope portions of drainageways are largely Carex spp.

View west over the broad Buckland Basin; continuous tussocky tundra cover is common; low, rounded hills of the Mount Conybeare Ecodistrict in the background

View north over gently rolling surfaces in the Buckland Basin Ecodistrict; low, rounded hills of the Mount Conybeare Ecodistrict and the nearly level Komakuk Plains Ecodistrict in the background

2.03 MALCOLM RIVER ECODISTRICT



The Firth River was not used to name any unit of land. The Firth traverses several ecodistricts; to name any one of them as the Firth River could mislead the reader into believing that one to be of most importance to the river. In the Malcolm River Ecodistrict, the Firth cuts its way through canyons incised into a relatively wide valley of rocky terraces. The channel occasionally makes abrupt turns. Its waters are of rare clarity. These are impressive waters even at low flow; at high flow they would be a major highlight.

Of special significance to the Malcolm River Ecodistrict is the occurrence of trees (white spruce) along the lower slopes and terraces of the Firth River valley. These trees are scattered along the Firth -- sometimes isolated, sometimes in stands. Along with a few other groves of spruce along the Malcolm River and its tributaries, both in this ecodistrict and in the British Mountains (2.04), these are some of the most northerly trees in the world.

The Malcolm River Ecodistrict is bordered to the north by the lower-elevation Mount Conybeare (2.01) foothills, the Buckland Basin (2.02), and the Komakuk Plains (1.01). To the west is the Alaskan border. Along the east, south, and southwest, the British Mountains (2.04) form another ecodistrict. Among other characteristics, there are topographic differences between these ecodistricts. The Malcolm River Ecodistrict is much lower in average elevation (675 m) than the British Mountains (2.04; 953 m), slightly reduced in local relief, and somewhat more regular in the orientation of its valleys.

The generally rounded mountains of this ecodistrict offer a wide variety of geomorphic features. Bedrock summits, talus and solifluction slopes, fans, residual deposits, cryoplanation terraces, rock and gravel river terraces, and gravel-bed headwater streams (dry in the summer) all abound. Some mountain ridges have east-west trending limestone crags. Placer gold is known in the Firth River gravels; in fact, there are contemporary workings at the junction of the Firth and Sheep Creek. Both the Firth and Malcolm have flows maintained by groundwater and aufeis melt. Arctic char and grayling are common.

The majority of the surface area of the Malcolm River Ecodistrict is colluvium which is all but devoid of vegetation. The lower portions of this colluvial detritus contain patches or stripes of vegetation largely of *Dryas integrifolia* along with *Vaccinium uliginosum*, *Salix reticulata*, other *Salix* spp, and *Betula nana*. Toe slopes generally have complete vegetation covers characterized by a number of species, including *Dryas integrifolia*, *Cassiope tetragona*, *Silene acaulis*, tussocks of *Carex microchaeta*, *Equisetum variegatum*, *Vaccinium uliginosum*, *Eriophorum vaginatum*, *Lupinus arcticus*, and *Salix* spp.

Pediments are largely tussock/dwarf to low heath tundra characterized by *Eriophorum vaginatum* and/or *Carex microchaeta* along with *Ledum palustre* ssp *decumbens*, *Betula nana*, *Vaccinium vitis-idaea*, *V. uliginosum*, and *Salix* spp.

The vegetation along the two major rivers of the ecodistrict, the Malcolm and the Firth, contrasts sharply because of the different natures of the channels. The Malcolm River has relatively broad, coarse-textured floodplains

with numerous inactive and active channels throughout most of its length in this ecodistrict. Thickets of Salix alaxensis and other Salix spp are widespread, but most of the floodplain is kept bare of vegetation by spring runoff. The borders of the floodplain are largely Salix pulchra and S. glauca. The Firth River, on the other hand, is largely contained in a narrow canyon-like channel with little vegetation along the floodplain. The borders of the river, however, are characterized by thickets of Salix alaxensis and Salix spp and a few scattered Picea glauca. On southerly facing slopes and terraces adjacent to the river, open stands of Picea glauca can be common, with understories of Salix spp and tussock tundra (on terraces) or alpine tundra (on slopes). Other streams within the ecodistrict are generally small and have gravel floodplains with scattered thickets of Salix alaxensis along with patches of Artemisia arctica, Potentilla fruticosa, Lupinus arcticus, and Epilobium latifolium. Stream borders are characterized by thickets of Salix pulchra, S. glauca, S. alaxensis, and other Salix spp along with Salix reticulata, Equisetum arvensis, Petasites frigidus, grasses, Polemonium acutiflorum, and Aconitum delphinifolium.

Sparsely vegetated, colluvium-covered angular mountains are typical of the Malcolm River Ecodistrict

Broad, coarse-textured floodplain of the Malcolm River and surrounding sparsely vegetated, colluvium-covered mountains; small patches of aufeis in the floodplain

Sparsely vegetated angular mountains covered with colluvium and frost-shattered bedrock

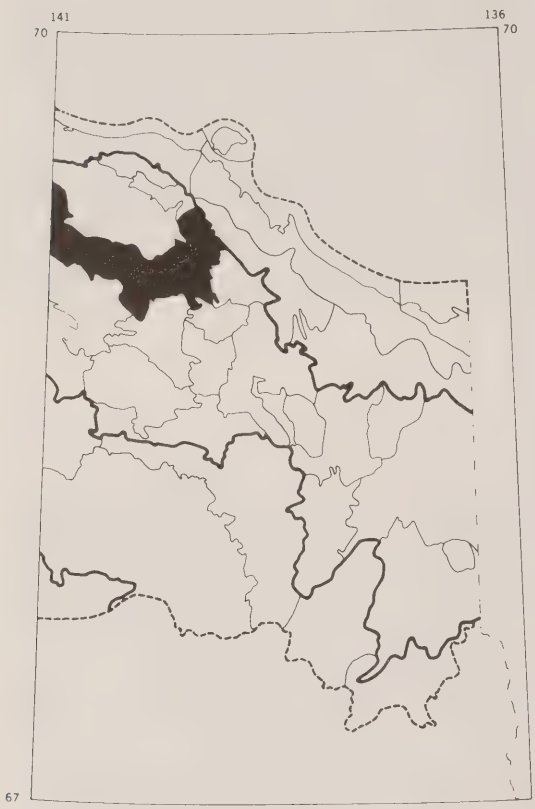
Angular mountains of the Malcolm River Ecodistrict; nearly barren or sparsely vegetated upper surfaces, and well-vegetated lower slopes and intermountain areas

Entrenched Firth River; scattered white spruce on upper terraces

Broad valley and narrow, entrenched channel of the Firth River; a former river channel is evident, and bedrock lies close to the river terrace surface

Entrenched channel of the Firth River; open stands or scattered white spruce on upper terraces of this portion of the river

2.04 BRITISH MOUNTAINS ECODISTRICT



The British Mountains Ecodistrict is much higher and more rugged than its continuation to the north, the Malcolm River Ecodistrict (2.03). It is typified by extensive upland and sloping surfaces of colluvium, with eroding crags, pinnacles, dyke-like ridges, and tors common throughout. Limestone ridges and pinnacles are dominant, but other sedimentaries (eg sandstone) and igneous and metamorphic (eg phyllite) rocks account for a greater proportion of the area. The relative abundance of these unvegetated colluvial surfaces sets the British Mountains Ecodistrict apart from others around it. Whereas the surrounding ecodistricts all have lowland basins, plains or at least relatively wide valleys, this ecodistrict is typified by narrow, V-shaped valleys with irregular, gravel-bed streams, mainly dry during the summer.

Many of the summits reach close to 1,300 m a.s.l.: the average local relief is 654 m. In places, however, some mountains reach 1,200 m above their surrounding valleys.

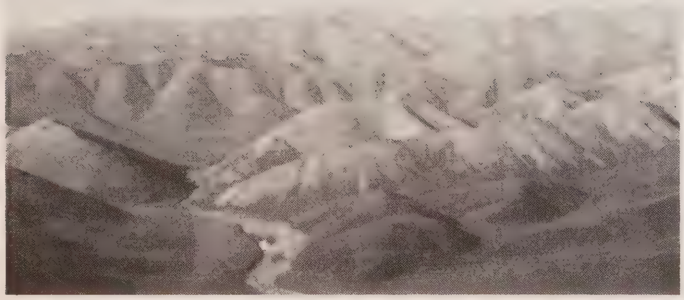
As in the Malcolm River Ecodistrict (2.03), the Firth River transcribes an irregular, incised route across the ecodistrict. Its gorge lacks both meander cores and floodplains, thus speaking of recent or on-going rejuvenation: the Firth is an antecedent stream crossing at right-angles to the grain of uplifted mountains. The Firth is in non-glaciated country, and so may be the only stream of its type in Canada, having less in common with the rest of the country than with, say, the Brahnputra or Indus rivers. The Firth River also links the Malcolm River (2.03) and British Mountains ecodistricts in providing habitat for extensive white spruce along the lower and south-facing slopes.

Vegetatively, the British Mountains Ecodistrict is similar to the Malcolm River Ecodistrict. Again, the majority of the colluvium is bare of vegetation. Lower mountain slopes and ridge tops have patches or stripes of vegetation consisting of Dryas octopetala along with Salix reticulata, Saxifraga oppositifolia, other Saxifraga spp, Antennaria spp, Silene acaulis, Potentilla uniflora, Papaver spp, and Senecio resedifolius. Toe slopes are characterized by Cassiope tetragona, Dryas integrifolia, Betula glandulosa, Salix reticulata, other Salix spp, Vaccinium uliginosum, Empetrum nigrum, Dryas octopetala, and Hylocomium spp.

Most streams within the ecodistrict have gravel floodplains which are largely bare of vegetation except for scattered thickets of Salix spp and Carex spp. The Firth River follows a narrow rock-walled canyon through the center of the ecodistrict. Terraces above the canyon walls have open stands of Picea glauca with understories of Salix spp along with tussock tundra or alpine tundra. Lower portions of many of the southerly-facing slopes also have open stands of Picea glauca, often appearing as scattered patches or stripes which are oriented in an up-down direction on the slope.

Pediments, where they occur, are largely covered with tussock/dwarf and low heath tundra mainly of Eriophorum vaginatum along with Ledum palustre ssp decumbens, Betula glandulosa, and mosses. Drainageways within the pediments are largely of Salix pulchra, S. glauca, and other Salix spp along with Betula glandulosa, Petasites frigidus, Rubus chamaemorus, and Sphagnum spp.

Tilted and folded formations of the British Mountains Ecodistrict



Rugged British Mountains, dominated by unvegetated or very sparsely vegetated colluvial side slopes and ridges

Sparse alpine tundra is associated with the higher elevation zones in the British Mountains

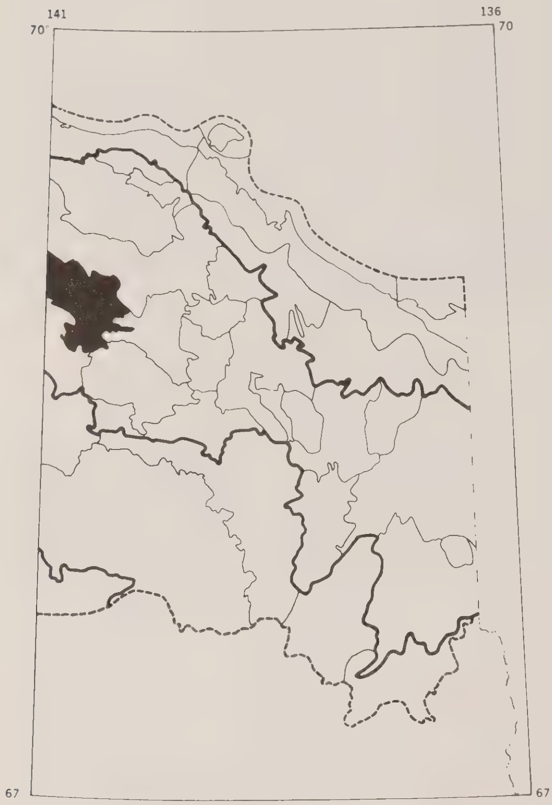
Insular pinnacles are striking features on ridges and side slopes

Extrusive bedrock (basalt), an uncommon bedrock in the northern Yukon

Extrusive bedrock and narrow, U-shaped valley in the British Mountains Ecodistrict

Ridge and valley wall pinnacles and barren, active colluvial slopes in the British Mountains

2.05 JOE CREEK ECODISTRICT



The Joe Creek Ecodistrict is in sharp contrast with the British Mountains Ecodistrict (2.04) to the north. The latter are high, colluvial-covered, and largely unvegetated mountains, whereas low hills and broad, vegetated valleys typify this area. Residual debris on cryoplanation terraces is common. To the south and east, this ecodistrict is bordered by limestone mountains and hills of much higher upland-to-lowland and bare-to-vegetated ratios.

Despite its relatively subdued relief, the Joe Creek Ecodistrict is nevertheless still mountainous in comparison with most areas. The limestone rocks of this area give rise to springs, with a major icing location on Joe Creek itself. Streams in this area have pH's exceeding 7.5, matched only by the Riggs Mountain Ecodistrict (2.07) where major icings also occur, and by the prominent limestone area, the White Mountains (2.20) to the southeast.

Residual and colluvial materials, talus and solifluction, dominate this area. Towards the Alaskan border, however, rock pinnacles and crags become frequent. Fluvial gravels are common along valley bottoms. Individual particles, as throughout the Northern Mountains Ecoregion, reach boulder size, speaking of heavy spring discharge and yet virtually zero summer discharges are the rule in all but the larger rivers.

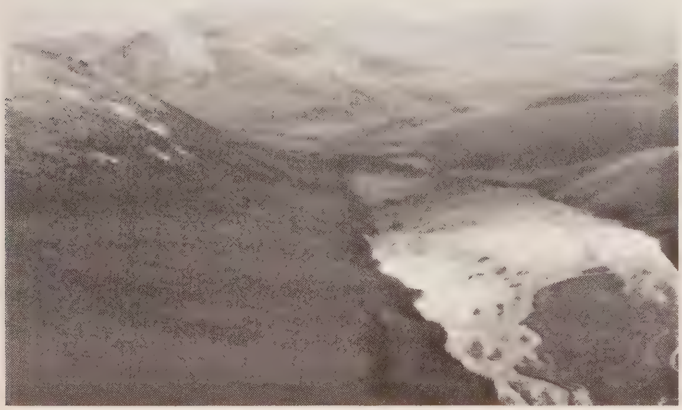
Icings, melting during the summer, contribute to the summer maintenance of rivers. Joe Creek has one of the more spectacular of these. The clear, blue ice, frozen into shards, forms an oasis of brightness amid the greenish-browns of the alpine tundra hillslopes. Tunnels of meltwater carve perfect meanders in the ice. Individual blocks of ice, up to hundreds of meters across and 1-2 m thick, overhang prominently at their edges. Lone caribou are a common sight on icings; the cool air on the icings may provide some relief from mosquitoes.

In the southwest corner of the Joe Creek Ecodistrict, where one of the right-bank tributaries of the Firth River, Muskeg Creek, flows out of the Timber Creek Ecodistrict (2.08), there is a small but distinctive, unique stand of mature balsam poplar. These trees are 12-15 m tall, and form a dense stand of several hectares situated on the gravelly floodplain of Muskeg Creek.

The Joe Creek Ecodistrict has a lower average elevation and latitude than the Malcolm River and British Mountains ecodistricts and as a result has a greater vegetative cover. Although the upper portions of the mountains are still mostly bare of vegetation, this ecodistrict also has a much higher proportion of trees and tall shrubs. The combined effects of lower latitude, gentler relief, and better access to warmer air from the south enable _Picea glauca_ to survive on lower portions of most mountain slopes, regardless of aspect. On slopes with a southern aspect, dense stands of _Picea glauca_ can occur and treed areas run further upslope. The understory on wooded slopes consists largely of _Dryas integrifolia_, _Cassiope tetragona_, _Salix_ spp, _Betula glandulosa_, _Alnus crispa_, _Vaccinium uliginosum_, and _Ledum palustre_ ssp _decumbens_, or, at higher elevations, alpine tundra consisting of _Dryas octopetala_, _Cassiope tetragona_, _Arctostaphylos alpina_, etc. Above the limits of trees, the

vegetation consists of scattered and poorly populated patches or stripes of Dryas octopetala, Salix reticulata, Saxifraga spp, Arctostaphylos alpina, Cassiope tetragona, etc.

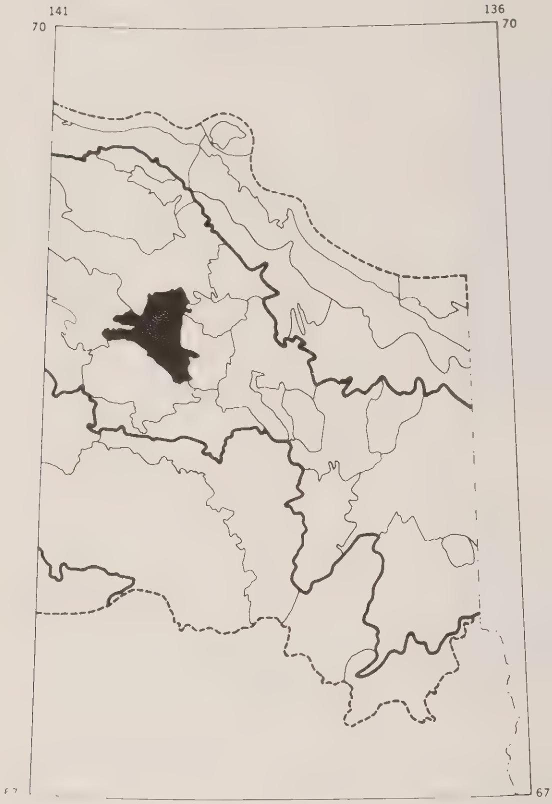
Typical broad, well-vegetated valleys and low, rounded hills of the Joe Creek Ecodistrict; former floodplains and stabilized terraces lie adjacent to the current floodplain



Low-relief hills and broad, vegetated valleys; Joe Creek aufeis in foreground; open white spruce stands often occupy south-facing or more protected slopes

'Joe's throne', a striking throne-like rock formation southeast of the Joe Creek aufeis

2.06 UPPER TRAIL RIVER ECODISTRICT



The Upper Trail River Ecodistrict consists of closely spaced angular mountains of high elevation and high local relief, mixed with large pediments occupying broad valleys. To the south, it borders the Timber Creek (2.08) Ecodistrict, a broad basin of low ridges and wide pediments. The other borders of this ecodistrict are less perceptible on the ground or on aerial photographs. Only on satellite imagery does the pattern of mountains and pediments become apparent.

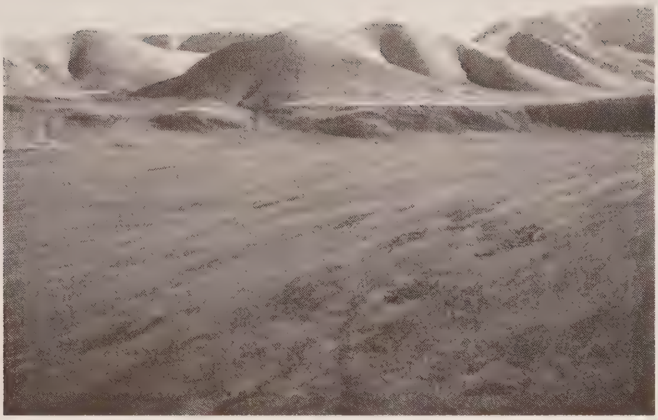
The mountains are covered by unvegetated colluvium and, occasionally, residuum on cryoplanation terraces. Rocky crags are also frequent, although their areal coverage is very small. On the lower ground, the pediments, river meadows, and gravelly floodplain and beds are vegetated by tussock and sedge communities, providing extensive areas for grazing. All of these features are seen to excellent advantage from the prominent but unnamed ridge in the center of the ecodistrict. This feature is of special merit for the extensive and dramatic prospect it provides on three sides. It should be ranked as one of the outstanding natural features of the northern Yukon.

This ecodistrict straddles the Yukon River/ Beaufort Sea drainage divide. Consequently, it has no major or exotic streams. The local streams are all of the irregular, flashy, gravel-bed type. There are no lakes.

Cover on the broad pediments of the Upper Trail River Ecodistrict is largely tussock/dwarf and low shrub tundra characterized by Eriophorum vaginatum and/or Carex microchaeta along with Betula glandulosa, Salix pulchra, S. glauca, Ledum palustre ssp decumbens, Salix reticulata, Vaccinium vitis-idaea, and Dryas integrifolia.

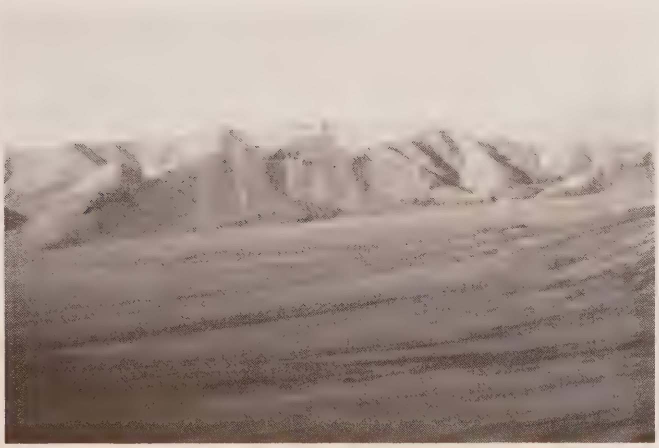
Mountain slopes are covered with colluvium and are largely bare of vegetation. Residuum on cryoplanation terraces supports sparse cover of mats of Dryas octopetala along with scattered Carex spp, Salix phlebophylla, grasses, Saxifraga spp, Pedicularis spp, and ground lichens (particularly Alectoria ochroleuca, Sphaerophorus globosus, and Cetraria nivalis). On lower portions of slopes, patches or stripes of vegetation are common, dominated by Dryas octopetala along with a variety of other alpine species.

Thickets of Salix alaxensis and other Salix spp are common along the restricted gravel floodplains of streams and thickets of Salix pulchra and S. glauca along stream borders. Drainageways are mainly Salix spp.



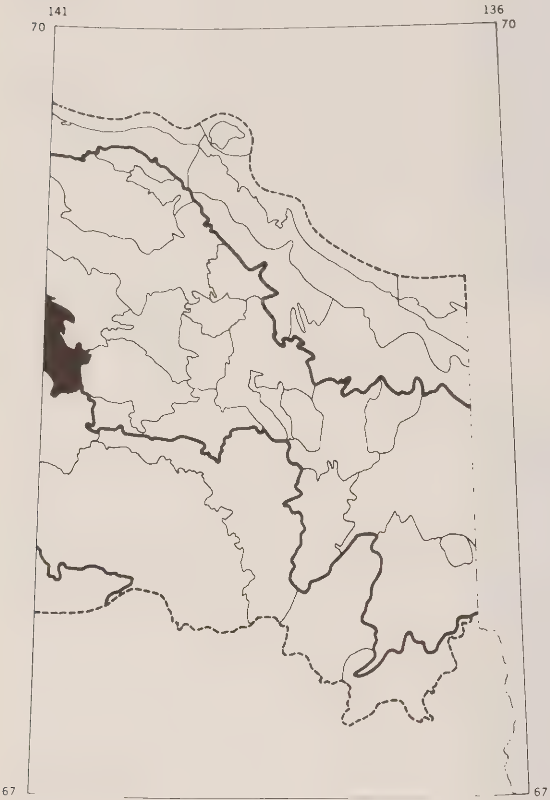
A mixture of closely spaced hills and mountains and broad, well-vegetated pediments typical of the Upper Trail River Ecodistrict

Sparsely vegetated to barren colluvial slopes of mountains and arctic tundra-covered broad valleys



Broad, well-vegetated pediments interspersed with mountainous ridges

2.07 RIGGS MOUNTAIN ECODISTRICT



The Riggs Mountain Ecodistrict differs only in minor detail from the Upper Trail River (2.06) Ecodistrict. They are described separately in this land survey for simplicity in mapping and interpreting and because of their differing special features. Outstanding in this ecodistrict are the very large icings on the Firth River. Up to 20 km of wide, braided channel are covered in ice, a feature visible from afar and clearly distinguished on LANDSAT imagery.

Apart from the valley of the Firth, the Riggs Mountain Ecodistrict is characterized by high, angular mountains. The calcareous bedrocks weather and erode to form extensive colluvial and bedrock areas, with the ubiquitous gravel-bed streams contributing to the third-ranking surface materials. As in the Joe Creek Ecodistrict (2.05) to the north, pH is high (generally above 7.5) in streams and soils.

The boundaries of this ecodistrict are marked on the north, east, and south by changes to land with a greater proportion of valley bottoms, fans, and pediments. To the west, the Alaskan border crosses a mountainous continuation of the Brooks Range: Riggs Mountain itself is in the United States.

Alpine tundra communities prevail in the Riggs Mountain Ecodistrict. Smoothly rounded ridges and gentle slopes have high covers consisting largely of extensive mats of Dryas octopetala along with Carex spp and Kobresia spp. On steeper slopes, cover is limited to the lower portions and is characterized by patches or stripes of Dryas octopetala along with Silene acaulis, Oxytropis campestris ssp gracilis, Draba nivalis, Trisetum spicatum, and Festuca brachyphylla.

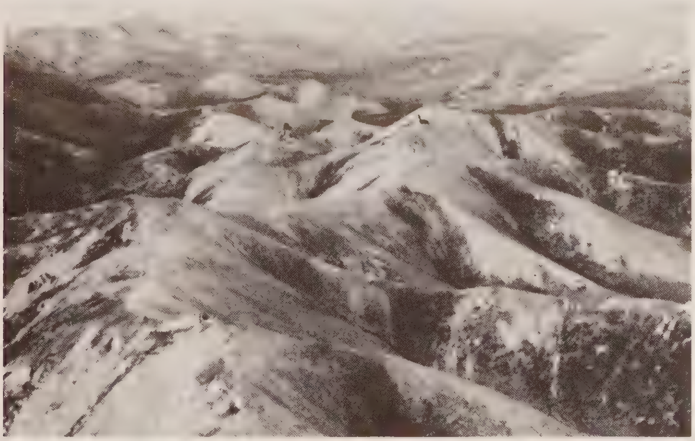
The Firth River valley, which splits the Canadian portion of the ecodistrict in half, is very wide in this area and has a large variety of vegetation. Excluding the massive aufeis, cover is generally medium-to-tall shrubs. Thickets of Salix alaxensis, attaining heights of up to 6 m, are scattered throughout the gravel floodplain. Salix arbusculoides, also attaining up to 6 m, is occasionally present with S. alaxensis, and S. glauca is common in the understory and along the margins of the floodplain. Dryas octopetala, Oxytropis campestris ssp gracilis, Lesquerella arctica, Epilobium latifolium, Hedysarum alpinum spp americanum, and Festuca spp are scattered across the floodplain. This broad valley also has other terrace communities which differ due to variations in substrate texture and hydrological conditions. Calcareous alluvium terraces, of low slope and silt-loam texture with good drainage and elevated a meter or more above the major gravel floodplain of the river, are characterized by Dryas integrifolia and Carex scirpoidea along with Elymus arenarius ssp mollis, Rhododendron lapponicum, Silene acaulis, and the lichens Thamnolia vermicularis and Cetraria telesii. Where gravel occurs on the surface, the terrace is dominated by Dryas integrifolia along with lichens. Poorly drained alluvial terraces may have sedge meadows dominated by Carex spp along with Eriophorum vaginatum and scattered Salix spp. Other poorly drained terraces are dominated by Sphagnum spp and shrubs, particularly Betula glandulosa, Ledum palustre ssp decumbens, and Vaccinium vitis-idaea. Sedges (particularly Carex spp) along with Betula glandulosa, Salix arctica, and Arctostaphylos alpina predominate on peat ridges in the terrace.

Terraces above streams and at higher elevations above the Firth River are often dominated by Picea glauca (generally 5-10 m high and with 7-21 cm dbh and occasionally up to 15 m high and with 30 cm dbh), and there are a few instances of a closed canopy. Salix alaxensis (up to 7 m high and with 10 cm dbh) and Populus balsamifera (up to 11 m high and with 23 cm dbh) are often present with the Picea glauca. The understory consists largely of Hylocomium splendens, Empetrum nigrum, Vaccinium uliginosum, Ledum palustre ssp decumbens, Arctostaphylos alpina, and a greaty variety of herbs, including Polygonum viviparum and a number of grasses and sedges.

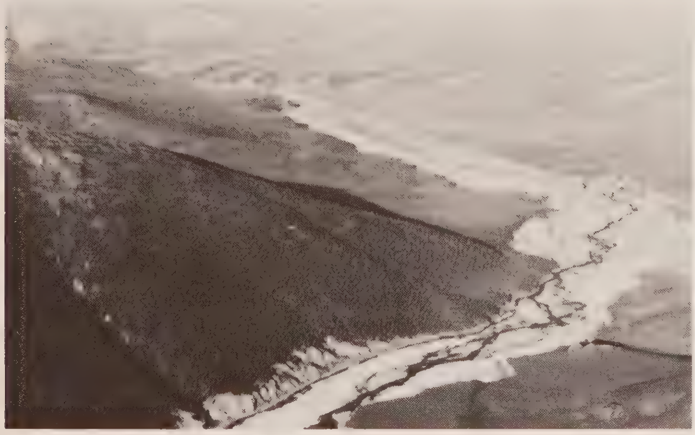
Scattered clumps or open stands of Picea glauca occur on many south-facing slopes, particularly along the Firth River and most streams. Cover, mean height, and dbh decrease with elevation.

Other vegetation on these slopes includes Potentilla fruticosa, Rhododendron lapponicum, Vaccinium uliginosum, Salix glauca, other Salix spp, and Shepherdia canadensis in a low shrub layer, and a ground cover of Dryas octopetala, Arctostaphylos alpina, A. uva-ursi, and Cassiope tetragona.

Some of the gentler north-facing slopes above rivers and streams have tussock/low shrub tundra consisting of Eriophorum vaginatum along with Betula glandulosa, Ledum palustre ssp decumbens, Empetrum nigrum, Vaccinium uliginosum, V. vitis-idaea, Arctostaphylos alpina, and Salix reticulata. Drainageways within the tussock tundra are typified by Alnus crispa (particularly on the lower portions of the slopes), Sphagnum spp, Salix spp, and Rubus chamaemorus.

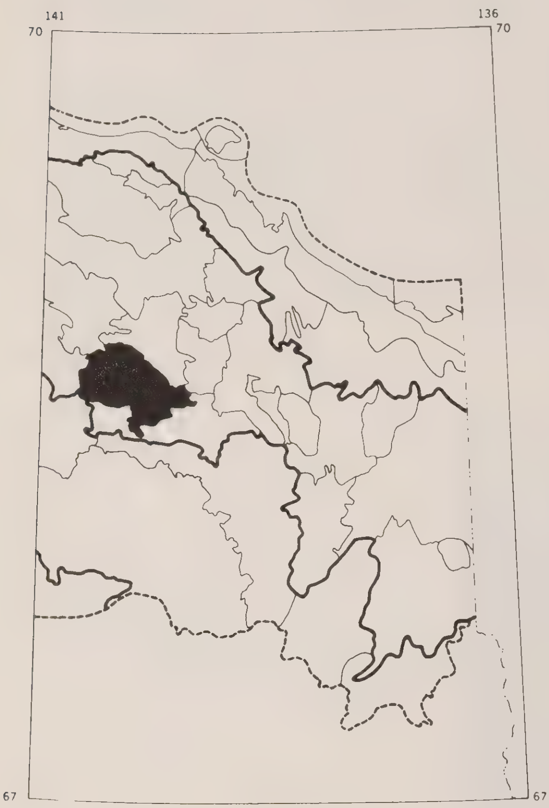


Sparse to discontinuous cover of alpine tundra and scattered white spruce on hills and mountains of the Riggs Mountain Ecodistrict; residual pinnacles common on the summits



Headwaters of the Firth River in the Riggs Mountain Ecodistrict; broad floodplains with braided channels, rounded mountains, and hills are common; white spruce forests occur on southerly exposures, alpine tundra dominates on more northerly slopes and at higher elevations, and arctic tundra communities prevail in lowlands

2.08 TIMBER CREEK ECODISTRICT



Almost surrounded as it is by the mainly calcareous hills and mountains of several ecodistricts, the Timber Creek basin becomes a distinctive feature of the Northern Mountains Ecoregion. This intermontane lowland is virtually an erosional plain, on which serpentine ridges of Jurassic shales and sandstones provide gently rounded uplands. From these develop extensive fans and pediments, on which the gravelly beds of ephemeral streams provide breaks from monotony. Apart from the bedrock ridges, this ecodistrict is a larger rendition of the Buckland Basin (2.02).

The absence of steep slopes and narrow valleys means little localized shelter from winds and little gain from aspect. Combined, these factors probably account for the absence of trees in this ecodistrict, despite the fact that spruce occur up to 30 km to the north along the Firth valley. Furthermore, cold air from the Arctic Ocean can penetrate relatively easily from the northwest, along the Babbage River lowlands. Coupled with a rain-shadow effect and the absence of limestone aquifers to help maintain summer base-flow, this area has a dry climate with associated semi-arid landforms such as pediments and ephemeral, gravel-bed streams. Despite this, fine-textured soils and a high permafrost table mean that soil moisture alone is probably not a limiting factor for plant growth. The larger streams in the basin, such as Muskeg and Timber creeks, do maintain some flow in summer, and small ponds on their floodplains remain water-filled. Melting of seasonal ground ice is probably the source of this water.

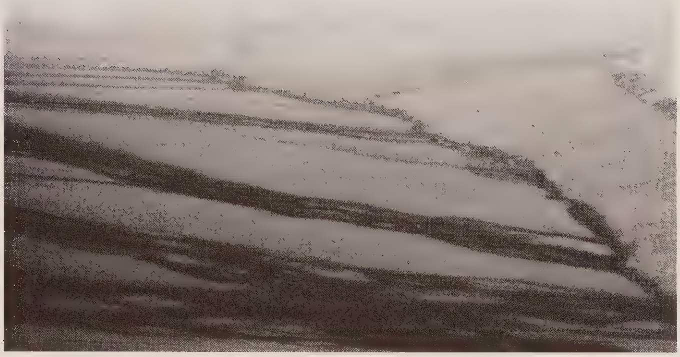
A distinctive feature of this ecodistrict is a horseshoe-shaped hill. This giant-size amphitheater stands out clearly on aerial photographs, generating a number of unwholesome epithets in its description!

The predominate vegetation type in the Timber Creek Ecodistrict is tussock/low-to-medium shrub tundra, characterized by Carex microchaeta and/or Eriophorum vaginatum along with Ledum palustre ssp decumbens, Arctostaphylos alpina, Rhododendron lapponicum, Betula nana, Salix reticulata, S. pulchra, S. Barriattiana, and mosses. A very striking feature of this ecodistrict is the pattern of streams and drainageways, which is accentuated by the sharp contrast between the dark greens of the streams and drainageways and the lighter yellow-brown and orange of the tussock/low shrub tundra. The continental divide splits the ecodistrict into northern and southern halves, and channels radiate out from the center of the ecodistrict -- Muskeg Creek and its tributaries in a northeasterly direction to the Firth River and the Babbage River to the east-northeast (both systems draining to the Arctic Ocean), and Timber Creek and its tributaries draining southerly to the Old Crow Flats.

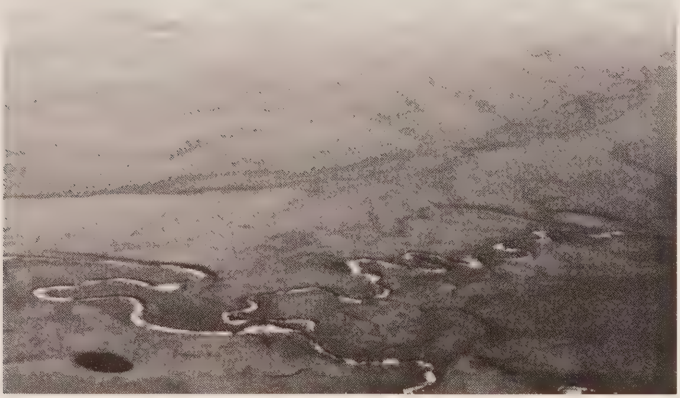
Mountain slopes in the ecodistrict are gentle, with lower portions being well-vegetated and upper portions consisting of patches and stripes of vegetation. Characteristic species include Dryas octopetala, Betula nana, Empetrum nigrum, and Arctostaphylos alpina.

Streams with a coarse-textured floodplain are typified by thickets of Salix alaxensis and thickets of other Salix spp. Stream borders are largely dominated by Salix pulchra, S. glauca, and other Salix spp, although sedge may

be abundant in poorly drained lowland areas around stream channels. Salix spp also predominate in the extensive drainageway networks of the ecodistrict.



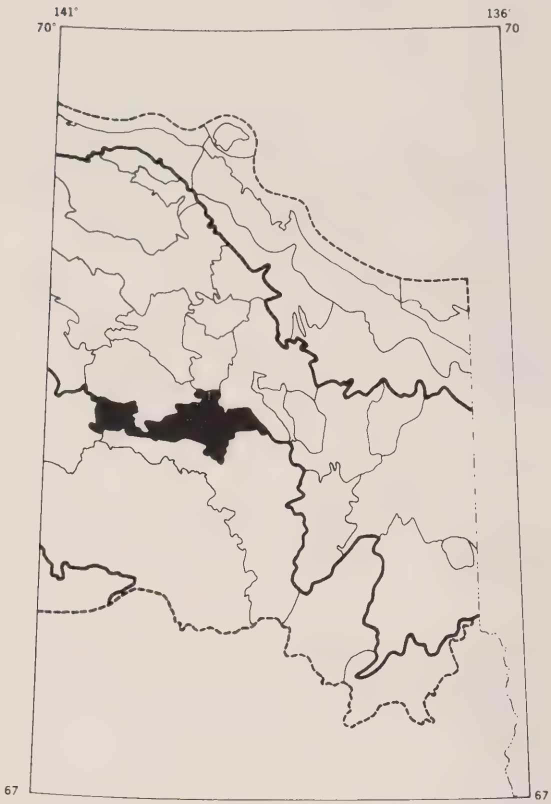
Intermontane lowland adjacent to Muskeg Creek; dark bands represent the sedge and willow cover of seepage/drainage areas



General view of basin; pediments, with arctic tundra cover, and meandering, shrub-dominated streams

Extensive pediments and meandering stream of the Timber Creek Ecodistrict

2.09 WHITEFOLD HILLS ECODISTRICT



The name of this ecodistrict was conjured up to describe the essential nature of the area. A series of ridges of folded, calcareous rocks of mainly Carboniferous and Permian age separate the Timber Creek Basin (2.08) and the Old Crow Basin (Ecoregion No. 3) to the north and south respectively. Apart from relatively minor details, the Whitefold Hills are similar to the West Barn Range Ecodistrict (2.11). Their relatedness is very evident, especially when their patterns on LANDSAT images are examined.

Upland slopes of talus merge downwards into extensive fans, aprons, and infrequent pediments. Compared to much of the British and Richardson ranges, these hills of low relief (335 m) are classed as ridges with broad valleys. Summits are generally subdued, such that bedrock outcrops are restricted in area. No major streams cross this ecodistrict; native streams are mainly gravel-bed in type, but downstream they merge to create small meandering creeks. Despite the prominence of limestone bedrock, there are no icings here. Rather, several occur in the Cottonwood Creek Ecodistrict (2.13).

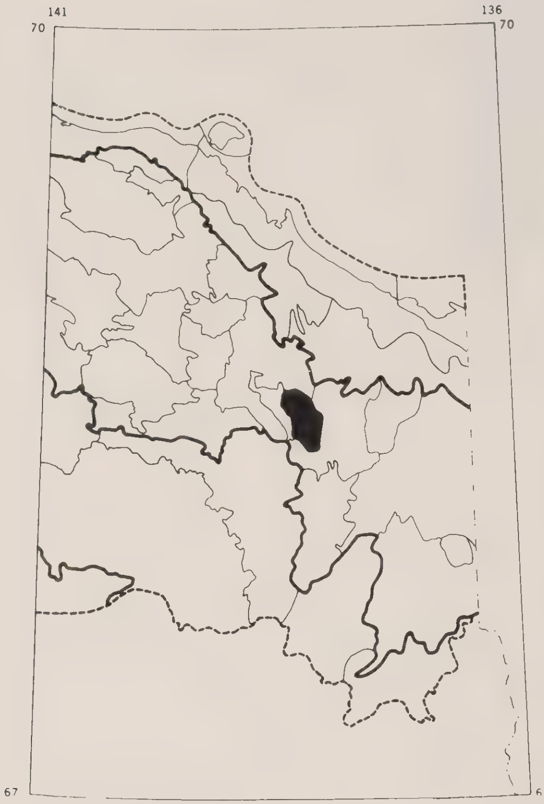
Vegetation of the alpine tundra grouping prevails in the colluvium of the Whitefold Hills Ecodistrict. It is characterized by widely scattered and poorly populated patches and stripes of *Dryas octopetala*, *Arctostaphylos alpina*, and *Saxifraga* spp. Lower, undulating slopes have broader patches and stripes of vegetation which include *Dryas octopetala* along with *Betula nana*, *Carex* spp, *Salix reticulata*, *Empetrum nigrum*, and lichens, particularly *Cetraria cucullata* and *Thamnolia vermicularis*. *Picea glauca* is abundant on many south-facing slopes.

Fans and pediments are covered with extensive tussocks and low shrubs. The composition, floristics, and structure are similar to the Timber Creek pediments.

Coarse-textured floodplains contain thickets of *Salix alaxensis*, *S. pulchra*, and *S. glauca* ssp *acutifolia*. Other stream floodplains and borders of streams have thickets of *Salix pulchra* and *S. glauca* ssp *acutifolia* along with *Lupinus arcticus*, *Polygonum bistorta*, and grasses. Drainageways in the ecodistrict are largely dominated by *Salix pulchra*, *Betula glandulosa*, and *Eriophorum angustifolium*.

Low, calcareous hills of the Whitefold Hills Ecodistrict; broad pediment in the foreground

2.10 EAST BARN RANGE ECODISTRICT



The East Barn Range is a clearly defined group of rounded mountains formed mainly from Precambrian and Paleozoic clastic sediments. These mountains are tightly spaced, with characteristically narrow valleys and a consequent lack of pediments or fans. Colluvium and residuum, followed by rock and fluvial gravels, are the main materials in this ecodistrict. All of the bordering ecodistricts are clearly distinguished by their lack of mountains and the presence of wider valleys and associated fans and pediments on the lower slopes.

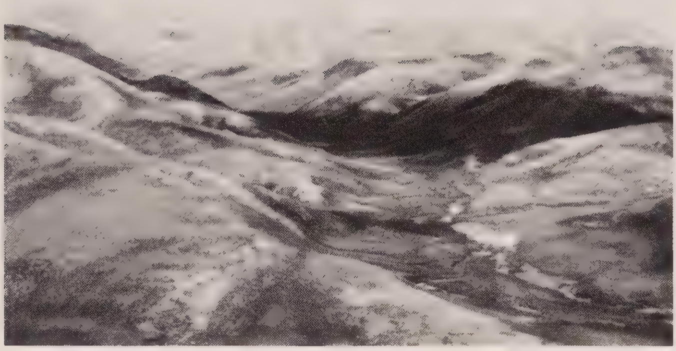
Beginning in this ecodistrict, and throughout the remainder of the Northern Mountains Ecoregion to the north and east of here, one is struck by the frequent occurrence of residual snow patches well into the summer months. This contrasts with the British Mountains. The explanation may lie in the movement of cold air masses southwestwards from the Beaufort Sea. These air masses, which are deflected around the British Mountains, may delay spring melts. The same mechanism is thought to contribute to the treeless aspect of the central parts of the Northern Mountains. The British Mountains, in the west, receive proportionately more air from the Pacific. These mountains, while considerably north of the East Barn Range, are conspicuously well-treed by comparison.

Many of the summits of the East Barn Range display rock outcrops, commonly flanked by short talus slopes. However, there is no distinct upper limit to vegetation; alpine meadows frequently extend across ridges and peaks. Tall, shrub-like willow communities abound along river valleys, the beds of which are gravelly, as throughout the Northern Mountains.

The lower and middle portions of the low, well-rounded hills of the East Barn Range Ecodistrict are covered with extensive patches and broad stripes of alpine tundra largely consisting of Dryas octopetala, Vaccinium vitis-idaea, Salix reticulata, S. phlebophylla, Arctostaphylos alpina, Vaccinium uliginosum, grasses, Carex spp, and Saxifraga tricuspidata. Upper portions of slopes and ridge-tops have sparser vegetative cover of scattered patches and stripes of Dryas octopetala, Arctostaphylos alpina, Salix reticulata, and Saxifraga spp.

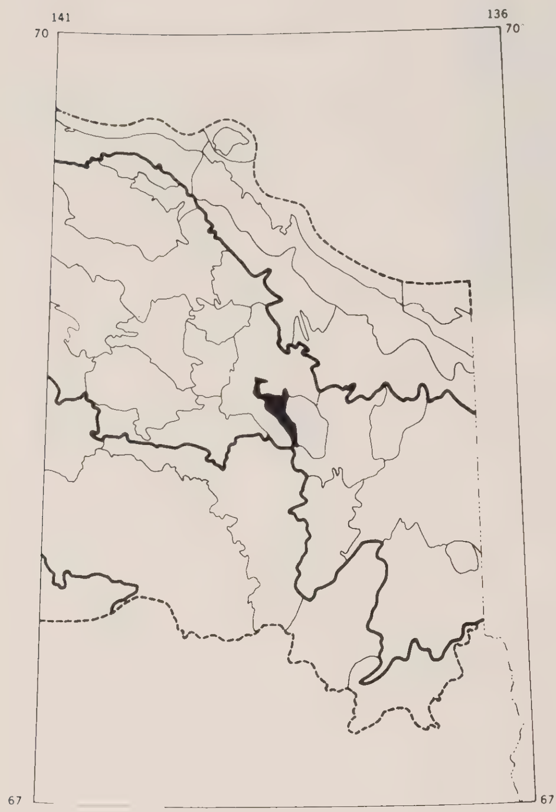
Fans and pediments have high vegetative covers, generally of tussock/low-to-medium shrub tundra characterized by Carex microchaeta (or Eriophorum vaginatum) along with Salix arctica, Betula glandulosa, Dryas octopetala, Salix phlebophylla, and S. reticulata. At lower elevations, Salix pulchra, S. Barrattiana, Vaccinium uliginosum, Ledum palustre ssp decumbens, Dryas octopetala, and Sphagnum spp are prevalent on the tussock tundra.

Coarse-textured floodplains have dense thickets of Salix alaxensis and other Salix spp. Salix pulchra and S. Barrattiana are common along the borders of streams and in drainageways, and in some cases cover extensive areas for many meters up to the lower portions of well-drained gravel slopes.



Tightly spaced, rounded mountains and hills and narrow valleys covered with shrubs and arctic tundra

2.11 WEST BARN RANGE ECODISTRICT



Spatially, the West Barn Range is a westward continuation of the East Barn Range Ecodistrict (2.10). Ecologically, however, it is more like an eastern outlier of the Whitefold Hills (2.09). There is the same underlying geology of folded Carboniferous and Permian limestones which have been denuded to become prominent sinuous ridges. In the West Barn Range, the valleys are more restricted in width than in the Whitefold Hills (2.09), and the drainage density is slightly less. In other respects, the two ecodistricts are essentially similar; they could have been grouped into one divided ecodistrict. As in the case of the Upper Trail River (2.06) and Riggs Mountain (2.07) ecodistricts, we decided to give separate identities to these pairs in order to simplify data handling and interpreting.

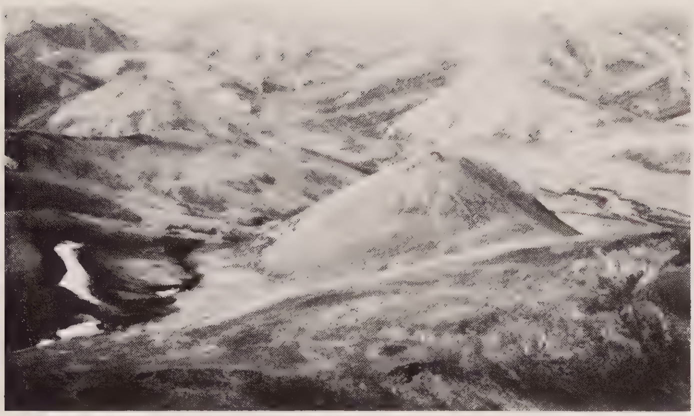
With respect to surface water, the West Barn Range is one of the driest ecodistricts in the Northern Mountains. There are no lakes or icings. Barren colluvial slopes extend well down into the valleys. The overall impression is of excessive water infiltration, with ground water being transported out of the area to reappear as springs and icings in the Blackfold Hills (2.12) to the north, and the East Barn Range (2.10).

The middle and upper portions of slopes of the low, rounded hills of the West Barn Range Ecodistrict have a very sparse vegetative cover, consisting of scattered patches and stripes of Dryas octopetala along with Carex spp, Salix reticulata, and lichens, particularly Cetraria cucullata and Thamnolia vermicularis.

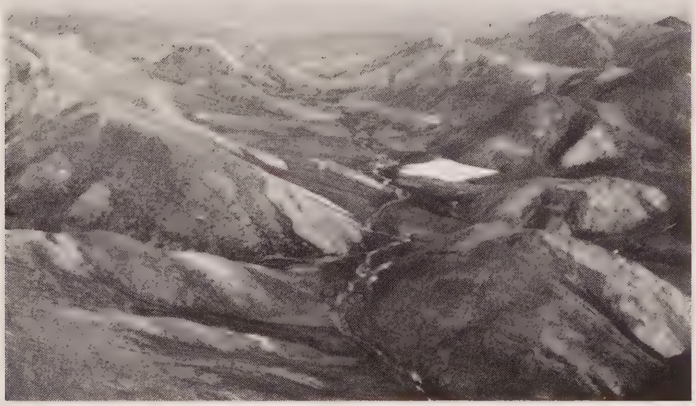
Colluvial fans are typified by a cover of Dryas octopetala, D. integrifolia, Cassiope tetragona, Carex spp, Salix reticulata, S. phlebophylla, Arctostaphylos alpina, and Aulacomnium spp.

Gravel floodplains of the largely intermittent streams contain thickets of Salix alaxensis, and stream borders and terraces are characterized mainly by Salix pulchra and S. glauca along with Lupinus arcticus, Polygonum bistorta, and grasses. Drainageways are dominated largely by Salix pulchra, S. glauca, Betula glandulosa, and Eriophorum angustifolium.

The pediments display tussock/low shrub tundra vegetation. The description parallels that given to the pediments of the Timber Creek Ecodistrict (2.08).

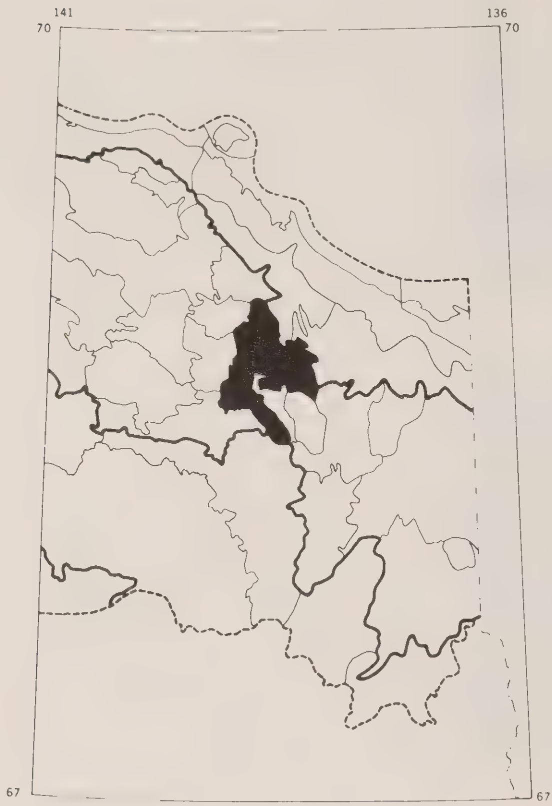


Low, sparsely vegetated mountains and hills, and narrow valleys with a continuous cover of shrubs and arctic tundra



Low, rounded, sparsely vegetated mountains and hills of the West Barn Range Ecodistrict; continuous cover of arctic tundra on the toe slopes, and mainly willows along stream channels

2.12 BLACKFOLD HILLS ECODISTRICT



As with the Whitefold Hills (2.09), the Blackfold Hills lack a suitable natural landmark which typifies the area. They are so-named because their appearance on LANDSAT colour composites is of dark, sinuous ridges scattered across broad, undulating lowlands. The ridges are of Upper Cretaceous shales and sandstones. The intervening lowlands are of similar lithology but are of Jurassic age. In gross topography, geology, and surface materials, this area is a close kin to the Timber Creek Ecodistrict (2.08). The Blackfold Hills, as their name suggests, have slightly more uplands.

Most of the upland surfaces are of barren, residual, or colluvial materials. These areas are limited in extent, so that treeless tundra covers extensive pediment surfaces. Most of the streams of the ecodistrict are gravel-bed or wetland types. Because of the relatively large size of the area, however, streams merge, become larger, and take on a meandering aspect. In the north, the Babbage River is cutting a wide meander belt which continues northwards across the Babbage Plains (1.05): bedrock outcrops are frequent along the steep meander bluffs. In this same northern part of the Blackfold Hills, there are a few lakes, the largest of which is Trout Lake.

A particularly distinctive feature is Sleepy Mountain, a steep-sided, cone-shaped mountain, volcano-like in appearance despite its sedimentary geology. Like the horseshoe hill in the Timber Creek Ecodistrict (2.08), this landmark also generates a number of anatomical epithets! Sleepy Mountain is conspicuously visible from most of the King Plains (1.03), Babbage Plains (1.05), and Running River (1.06) ecodistricts.

The vegetation on the extensive pediments and fans of the Blackfold Hills Ecodistrict is tussock/low-to-medium shrub tundra. It is largely Eriophorum vaginatum along with Ledum palustre ssp decumbens, Betula nana, and Vaccinium vitis-idaea; the heathland is characterized by Ledum palustre ssp decumbens, Vaccinium vitis-idaea, and Betula nana or B. glandulosa in the moister areas and Arctostaphylos alpina, Vaccinium uliginosum, Cassiope tetragona, and Empetrum nigrum in the drier areas. On higher, steeper slopes, Dryas octopetala is the predominant species along with a variety of alpine species, and the uppermost portions of a few slopes have very sparse cover or none at all.

Stream floodplains are largely coarse-textured and are often very broad. They are typified by thickets of Salix alaxensis along with S. pulchra and other Salix spp. Drainageways are very numerous in this ecodistrict and are predominately Salix pulchra in the lower (downslope) portions, and Carex aquatilis along with Salix pulchra, Equisetum arvense, Sphagnum spp, and Rubus chamaemorus in the higher (upslope) portions.

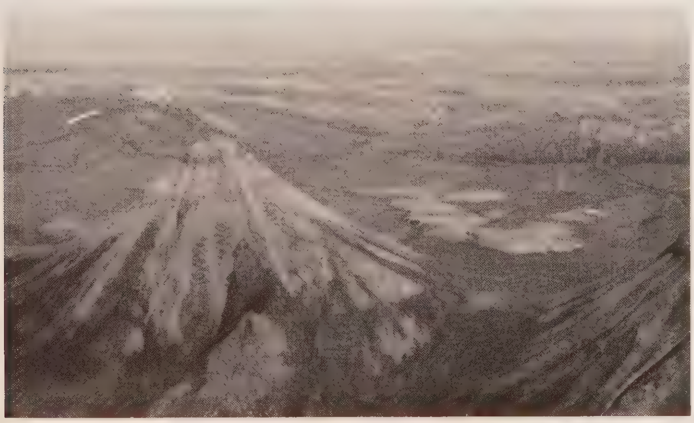
Some open stands of Picea glauca occur on slopes of southerly access above some of the stream channels of the ecodistrict. Alnus crispa is also found on some slopes.

The vegetation around Trout Lake, especially near the lakeshore, is particularly rich and very colourful in mid-summer. The list of flowering herbs around the lake includes Aconitum delphinifolium, Lupinus arcticus, Castilleja caudata, Epilobium latifolium, E. angustifolium, Aster sibiricus, Mertensia

paniculata, Polygonum bistorta, Saxifraga tricuspidata, Artemisia glomerata, Arnica frigida, and Stellaria sp. Alnus crispa, Potentilla fruticosa, Ribes triste, and a variety of grasses are also common along the shore.

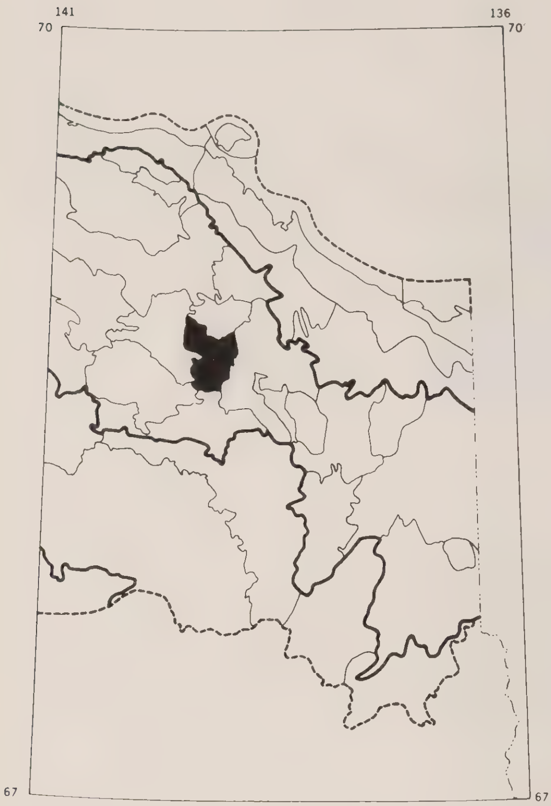
Tundra-covered pediment surfaces and a portion of a sinuous, flat-topped ridge in the background

Rolling to hilly terrain in the Blackfold Hills Ecodistrict; broad stream floodplains with meandering and often braided channels



The cone-shaped 'Sleepy Mountain' -- an inselberg; surrounding hilly to rolling terrain in the Blackfold Hills Ecodistrict

2.13 COTTONWOOD CREEK ECODISTRICT



The headwaters of the Babbage River are in the south of this ecodistrict. Three prominent icings mark the discharge of groundwater from limestone aquifers which collect water from several surrounding ecodistricts. In the headwaters of the Babbage, therefore, one can expect waters with a year-round flow, moderate temperature variations relative to tundra streams, and a high pH, probably in excess of 7.5.

The presence of this aufeis reflects the main physiographic characteristic of the Cottonwood Creek Ecodistrict, that of an undulating lowland covered by extensive pediments, residual surfaces, and a few bedrock ridges. On all sides except the northeast, where the Babbage flows, the ecodistrict is bordered by elongated hills or mountains of folded sedimentary rocks. The area has a high density of gravel-bed and wetland streams; there are no lakes.

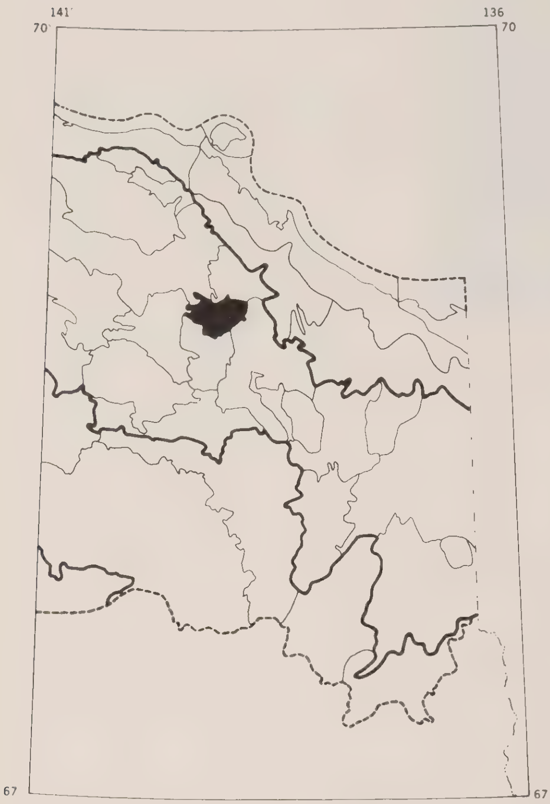
The extensive areas of pediments and fans in the Cottonwood Creek Ecodistrict are covered by *Eriophorum vaginatum* along with low *Ledum palustre* ssp *decumbens*, *Betula nana*, *B. glandulosa*, and *Vaccinium vitis-idaea*.

Residual and colluvial materials are typified by generally sparse covers consisting largely of mats of *Dryas octopetala* along with *Arctostaphylos alpina*, *Salix reticulata*, *Saxifraga* spp, and other alpine species.

The Trail and Babbage rivers, Gravel and Cottonwood creeks, and many ephemeral streams have very broad gravel floodplains dominated by thickets of *Salix alaxensis*; other *Salix* spp cover the borders of the stream floodplains, stream terraces, and lower slopes of valleys. The pediments and fans of the ecodistrict are highly dissected by drainageways. The lower (downslope) portions of these are typified mainly by *Salix* spp, and the higher (upslope) portions are largely *Carex aquatilis*.

Rolling, tundra-covered lowland with the Whitefold Hills in the background

2.14 MOUNT SEDGWICK ECODISTRICT



The Mount Sedgwick Ecodistrict is a series of rounded mountains which mark the most easterly extension of the Brooks Range and its Canadian continuation, the British Mountains (2.04). To the south, east, and north, this area is bordered by the lowlands of several ecodistricts. To the west, the land changes to angular mountains of much greater elevation and local relief. Local streams, which are of the gravel-bed type, are few, and there are no lakes. The Tulugaq (Crow) River and Gravel Creek both cross this ecodistrict, forming incised meanders.

Residual, colluvial, and fluvial deposits dominate, mostly covered by treeless tundra. Rock outcrops are few and are usually very subdued features.

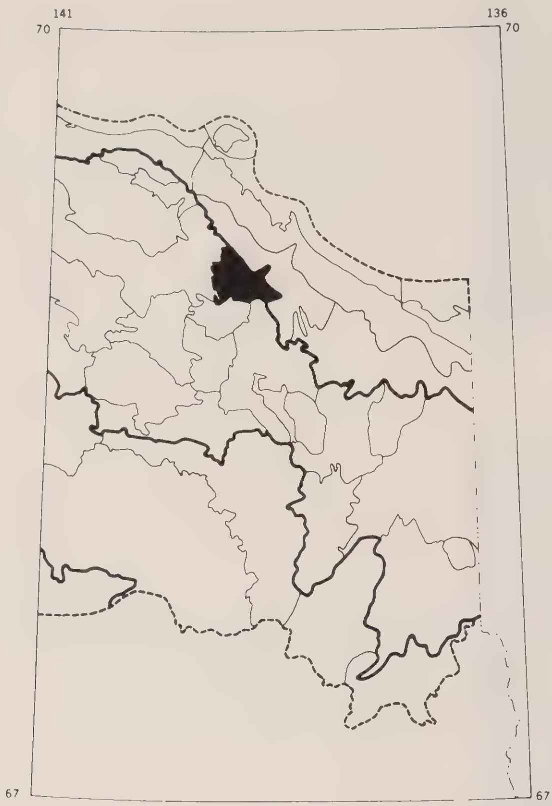
The middle and upper portion of the low, rounded mountains of the Mount Sedgwick Ecodistrict are typified by very sparse covers consisting of patches and stripes of *Dryas octopetala* along with other alpine species. The lower portions of slopes, including fans along the Tulugaq and Trail rivers and their tributaries, are characterized by *Dryas octopetala*, *Arctostaphylos alpina*, *Betula nana*, *Cassiope tetragona*, *Vaccinium uliginosum*, *Salix reticulata*, and *Empetrum nigrum*. Mosses (particularly *Hylocomium splendens* and *Aulacomnium* spp) and ground lichens (especially *Cetraria cucullata*, other *Cetraria* spp, *Thamnolia vermicularis*, and *Dactylina arctica*) may be locally abundant.

The coarse-textured floodplains of the ecodistrict have thickets of *Salix alaxensis* along with other *Salix* spp, and stream borders and terraces are characterized by thickets of *Salix pulchra*, *S. glauca*, and other *Salix* spp. *Alnus crispa* occurs on the lower portions of some slopes. Lower portions of drainageways are largely *Salix* spp and upper portions are mainly *Carex aquatilis*. The pediments are covered with tussocks and dwarf heath. The Tulugaq Pediments (2.15) have a similar vegetative cover.

Barren to sparsely vegetated, low, rounded, colluvium-covered hills and well-vegetated fans and pediments characteristic of the Mount Sedgwick Ecodistrict

Rounded, colluvium-covered mountains and hills with shallow, U-shaped valleys; sparse vegetative cover on upper surfaces, whereas continuous or discontinuous cover of mountain avens, heath species, and mosses on lower portions of slopes

2.15 TULUGAQ PEDIMENTS ECODISTRICT



Topographically, the Tulugaq Pediments Ecodistrict is a southward extension of the Northern Coastal Plain Ecoregion. There is a sharp difference, however, in their geomorphology. As the name of this ecodistrict suggests, it is not a glaciated land. The northern border of the ecodistrict marks the limit here of Quaternary glaciation. There are a number of consequences to this. Although larger streams and their valleys provide some relief, the general aspect is one of smooth, gently sloping pediments of tundra-covered silty materials. Most streams on the pediments are restricted to wetland types -- seepage along well-defined lines. There are only a few lakes, these being of less than 5 ha and occurring on Peatbog Creek in the center of the ecodistrict.

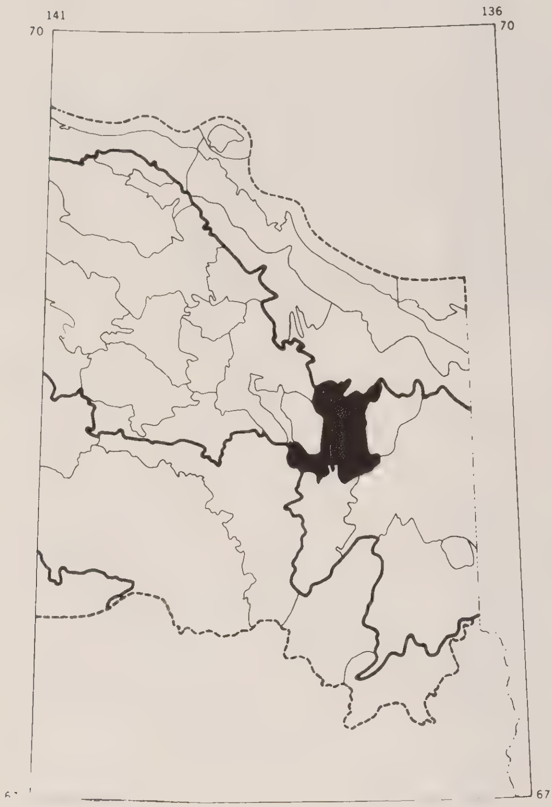
The predominant vegetation in the Tulugaq Pediments Ecodistrict is tussock/low heath tundra, typified by Eriophorum vaginatum along with Betula nana, Ledum palustre ssp decumbens, and Vaccinium vitis-idaea. Sphagnum spp are prevalent in the wetter portions of the tussock tundra, and Empetrum nigrum, Vaccinium uliginosum, and Aulocomnium spp are common in drier sites.

The coarse-textured floodplains of the rivers and streams support dense thickets of Salix alaxensis, S. pulchra, and other Salix spp. Stream borders and terraces are also typified by Salix spp. The ecodistrict is finely dissected by numerous drainageways which are dominated in the upper portions by Carex aquatilis and in the lower portions by Salix pulchra along with Betula glandulosa, Sphagnum spp, and Rubus chamaemorus.

Extensive, gently sloping pediments covered with tussocky cottongrass-trailing heath tundra; lush sedge and willow cover in the abundant seepage/drainage lines

Extensive, rolling pediment surfaces, characteristic of the Tulugaq Pediments Ecodistrict; mainly tussocky cottongrass-trailing heath communities, with willows abundant along the stream channels

2.16 BLOW PASS ECODISTRICT



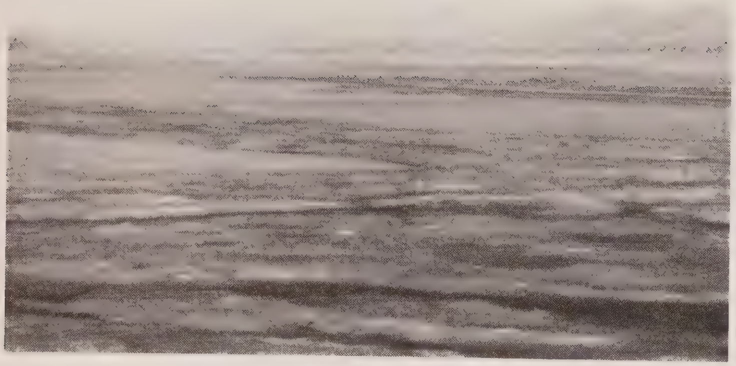
The Blow Pass is a series of low hills separating the Barn ranges from the Richardson Mountains. To the north, the pass terminates against the limit of glaciation. To the south, it grades into the Bonnet Lake Ecodistrict (2.19). The latter has more extensive valleys and pediments and has less local relief despite a higher elevation.

The Blow Pass Ecodistrict is an area of gentle slopes and rounded hills. Most of the area is sedge/heath-covered, although residual-covered rock outcrops and stone-centered hummocks are both common. Much of the remainder is of tussock-covered pediments. Although the area occupies a major drainage divide, it is large enough that its native streams develop incised meanders before exiting to the north. These streams introduce the third main landform of the ecodistrict -- alluvial floodplains.

At higher elevations (in the foothills of the Barn Range and Richardson Mountains), Carex microchaeta dominates along with Ledum palustre ssp decumbens, Vaccinium vitis-idaea, Betula nana, Arctostaphylos alpina, Vaccinium uliginosum, Salix spp, and Eriophorum vaginatum. At lower elevations, in the 'pass' itself, Eriophorum vaginatum predominates along with Ledum palustre ssp decumbens, Betula nana, and Vaccinium vitis-idaea. Sphagnum spp and Rubus chamaemorus are prevalent in the wetter sites of the pass, and Vaccinium uliginosum and Arctostaphylos alpina are common in the drier sites.

Channels of the Blow River and its tributaries are deeply incised in this ecodistrict, and the coarse-textured floodplains are dominated by thickets of Salix spp. Stream borders and terraces also have thickets of Salix spp, and Alnus crispa and Salix spp also form thickets on many of the long, steep slopes above the river and stream channels. Drainageways are typified by Salix spp, Sphagnum spp, Eriophorum Scheuchzeri as well as plants such as Carex spp, Betula glandulosa, and Rubus chamaemorus.

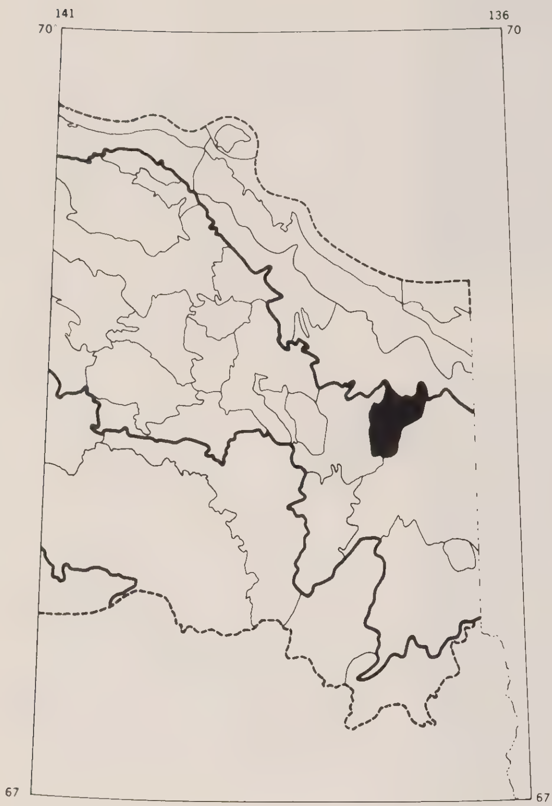
Alpine tundra occurs in the higher elevations of the perimeter of the ecodistrict and on exposed rock in the pediments. Principal species include Dryas octopetala, Carex spp, and Arctostaphylos alpina.



Mostly continuous cover of arctic tundra is characteristic of the Blow Pass Ecodistrict

Low hills and nearly level to gently rolling pediments and terraces; meanders and entrenched channels are common in this unit; hills and mountains of the Purkis Creek Ecodistrict in background

2.17 PURKIS CREEK ECODISTRICT



Cretaceous shales and sandstones are the main constituents of these closely spaced, rounded mountains. The absence of wide valleys precludes significant pedimentation. Instead, colluvium, mainly in the form of talus, dominates. These slopes are largely bare or, at the most, lichen-covered. The lower slopes display tundra-covered fans and river terraces.

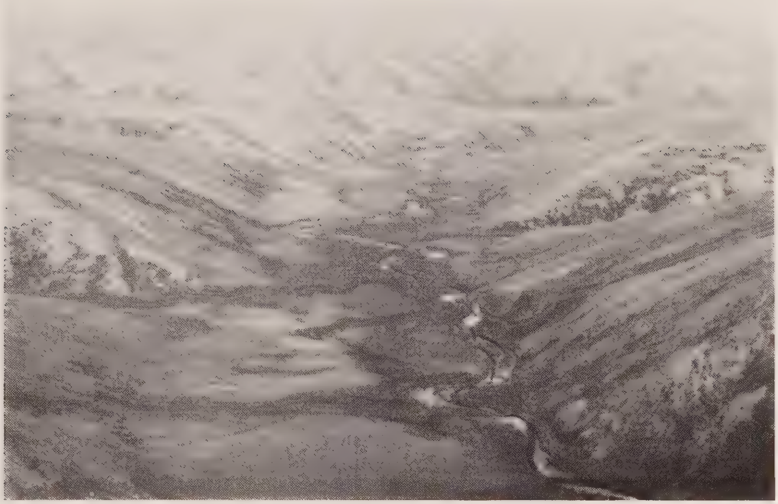
The Purkis Creek Ecodistrict is triangular in shape, with its 'fans' at the north. The north and west sides are marked by a change from the mountains of Purkis Creek to the hills and lowlands of the Blow Pass (2.16) and Running River (1.06) ecodistricts. To the east, the Richardson Mountains are similar in form, but are higher, have more local relief, and are more obviously related to elongated fold structures in the bedrock.

There are neither lakes nor exotic streams in this ecodistrict. The longer streams of the area become incised meanders before leaving the area, so that rejuvenated, raised terraces are common. The pH's are low, as throughout most of the Richardson Mountains.

Alpine vegetation is widespread throughout the Purkis Creek Ecodistrict. Middle and upper portions of slopes are largely bare except for patches and stripes of Dryas octopetala, Arctostaphylos alpina, Saxifraga spp, etc. Lower portions of slopes have more extensive mats of vegetation consisting of sedges and low shrubs. Present are Dryas octopetala, Arctostaphylos alpina, Vaccinium uliginosum, Empetrum nigrum, Betula nana, and Salix spp. A few scattered Picea glauca may be found near the base of some southerly facing slopes.

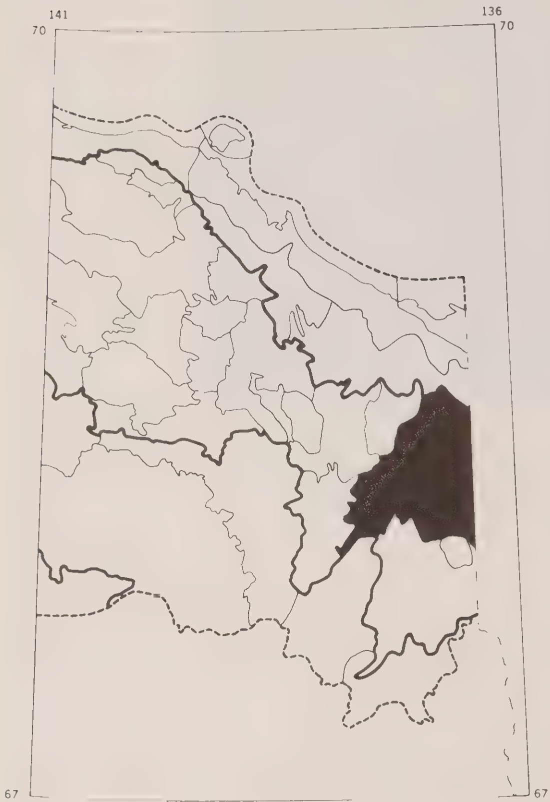
Stream floodplains are generally coarse-textured and support thickets or scattered individuals of Salix alaxensis. Borders of floodplains and terraces above stream channels are predominantly Salix spp. Most of the gravel slopes above the deeply incised streams are bare of vegetation or have scattered small thickets of Salix spp or Alnus crispa. Drainageways are covered mainly by Salix spp and/or Carex aquatilis and other sedges.

Fans in the ecodistrict have covers of tussock tundra characterized by Eriophorum vaginatum as well as Ledum palustre ssp decumbens, Betula nana, Vaccinium vitis-idaea, and bryophytes.



Rounded, sparsely vegetated, colluvium-covered mountains and hills interspersed with tundra-covered foothills and terraces; willow thickets predominate in most main stream channels, sometimes with alder present

2.18 RICHARDSON FOLDS ECODISTRICT



The Richardson Mountains range north-south along the Yukon/Northwest Territories border. At this latitude, they mark the eastern front of the Western Cordillera and the western edge of the Interior Plains, here represented by the Mackenzie Delta. Within the area covered by this study, the Richardson Mountains are represented by three ecodistricts: Purkis Creek (2.17), Richardson Folds, and Bell River (2.21). The small White Mountains Ecodistrict (2.20) is sandwiched between the latter two. Its character contrasts strongly with the rest of the Richardsons.

The Richardson Folds Ecodistrict consists of extensive, rounded, widely spaced, eroded fold structures of Mesozoic shales and sandstones. In elevation and relief, they are transitional from the high, angular mountains of the Bell River and relatively low Purkis Creek ecodistricts. Along its northern boundary, the Richardson Folds Ecodistrict terminates against the glaciated plains of the Running River (1.06). To the west, the Richardson Folds limit is marked by areas of extensive pedimentation (Blow Pass, 2.16; Bonnet Lake, 2.19; Driftwood River, 3.04).

The surfaces of the Richardson Folds are of extensive residual and colluvial debris, with pediments, fans, and river deposits also very common. The latter, although recurring frequently, are small in total area, since most streams and rivers are actively incising, generating spectacular meanders, bluffs, and terraces. It is common to see several meters of river gravels exposed along the tops of rocky meander bluffs up to 50 m high. Above these gorges and chasms, the landscape offers wide vistas of treeless hills and mountains.

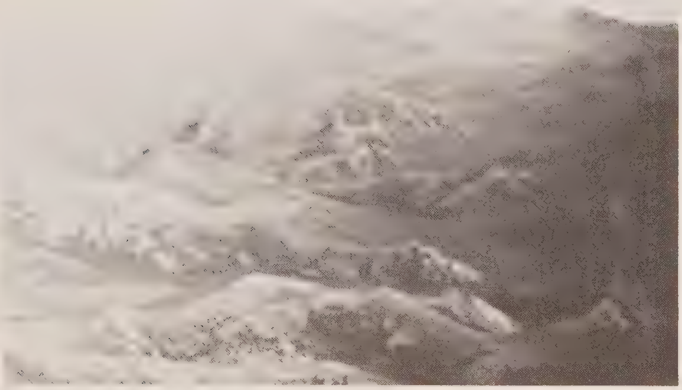
Common to most of the Richardson Mountains, surface waters have pH's less than 6.5. This appears to coincide with bedrock of clastic sediments, for it is the calcareous White Mountains (2.20) that provide the exception. Similarly, there is a tendency for icings to correlate to the nearby presence of limestones: there are no icing locations in the Richardson Folds.

Alpine barrens predominate on the residual and colluvial materials of the Richardson Folds Ecodistrict. The middle and upper portions of the low and moderately sloping hills are characterized by patches and stripes of largely Dryas octopetala, Arctostaphylos alpina, Salix spp, and Saxifraga spp. These areas are not densely vegetated. The lower slopes are typified by extensive mats mainly of Arctostaphylos alpina, Empetrum nigrum, Cassiope tetragona, and Salix spp.

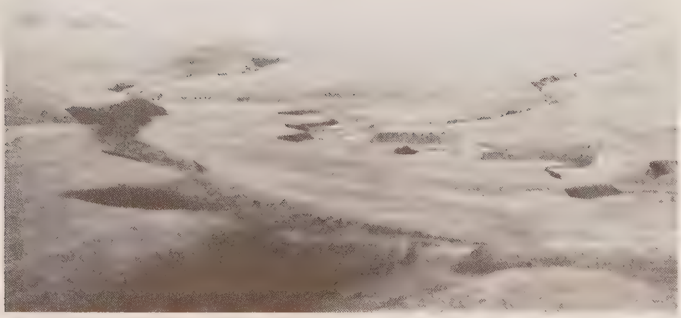
Fans and pediments are largely covered with tussock/dwarf and low shrub tundra characterized by Eriophorum vaginatum and/or Carex microchaeta along with Betula nana, Ledum palustre ssp decumbens, Vaccinium vitis-idaea, V. uliginosum, Arctostaphylos alpina, Salix spp, and bryophytes.

River and stream floodplains are predominantly of gravel or larger rock fragments and are typified by thickets or scattered individuals of Salix alaxensis. Thickets of Salix pulchra or S. glauca are common along the borders of the floodplains, and terraces above the stream channels are largely Salix spp and Betula glandulosa, along with Vaccinium uliginosum and Ledum palustre ssp decumbens. Drainageways are mainly Carex aquatilis and/or Salix spp.

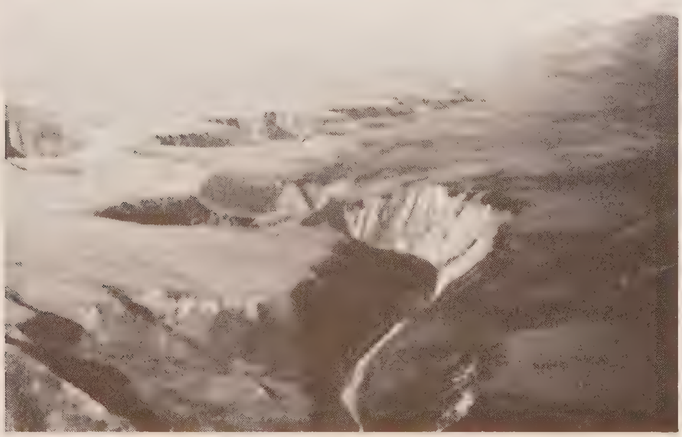
Alnus crispa grows on the lower portions of some gravel slopes above streams, and Populus balsamifera occurs on slopes above the upper Bell River.



Rounded, eroded fold structures of the Richardson Mountains; sparse alpine tundra cover of upper surfaces grades to a continuous cover of heath species, willows, and sedges on lower slopes and valley terraces

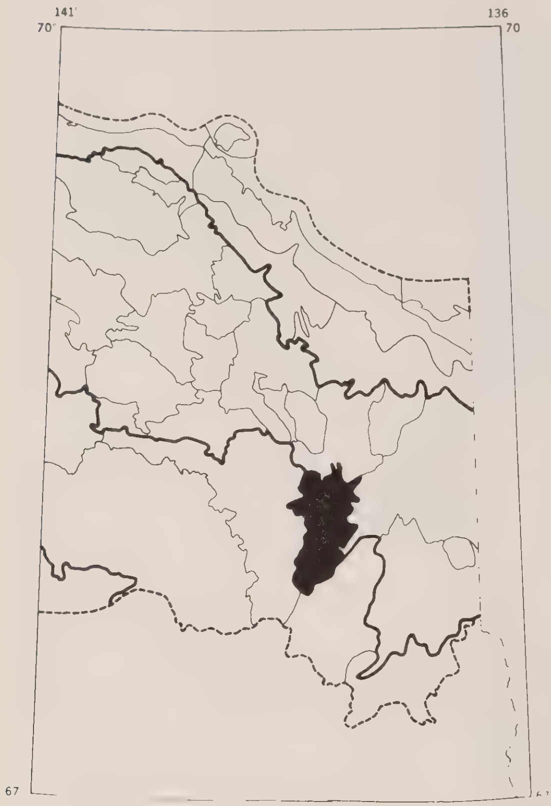


Rolling, tundra-covered intermontane pediments and foothills and old river terraces; meandering rivers with deeply incised channels are common



Meanders of Rapid Creek are deeply incised into bedrock

2.19 BONNET LAKE ECODISTRICT



The Bonnet Lake Ecodistrict is a series of low hills and wide valleys. This area is transitional from the plains of the Old Crow Basin Ecoregion and the Richardson Mountains. To the north and east, it is distinguished from the Blow Pass (2.16) and Richardson Folds (2.18) ecodistricts by lower local relief and a much lower drainage density. On the remaining sides, the Old Crow Pediments (3.03) and the Driftwood River (3.04) ecodistricts are plains lacking in the low hills of folded clastic rocks which are common in the Bonnet Lake Ecodistrict.

This area is approaching an erosional peneplain. Extensive plateaux (of residual deposits) and pediments are the dominant landforms. Most of the area is drained by seepage along depressions in the pediment surfaces. The density of streams, which here are of the meandering type, is very low.

Bonnet Lake itself is one of a very small number of lakes which occur on the intermontane lowlands and pediments of the Northern Mountains Ecoregion. Their origin appears to be consequent upon the folding of the underlying bedrock. If this is so, then these lakes may be up to tens of millions of years old. In this case, they could be very valuable scientific resources for their bottom sediments and their information on climatic changes and past environments.

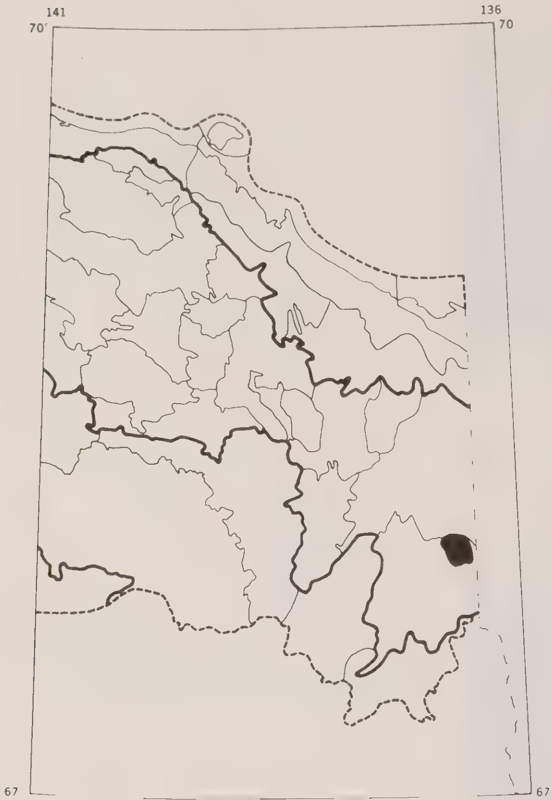
The primary cover in the Bonnet Lake Ecodistrict is tussock/low shrub tundra characterized by *Eriophorum vaginatum* and/or *Carex microchaeta* along with *Betula nana*, *Ledum palustre* ssp *decumbens*, *Salix pulchra*, *Vaccinium uliginosum*, and bryophytes. In the north-central portion of the ecodistrict, the tussock community species form the rims of polygon-like formations; the centers of these are depressed and dominated by *Eriophorum angustifolium* and *Carex aquatilis* along with a few scattered *Salix* spp. Stunted *Picea glauca* are also widely scattered throughout this portion of the ecodistrict.

Alpine species predominate in the low, rounded hills at the western, southwestern, and eastern perimeters of the ecodistrict.

Low, rounded, sparsely vegetated hills (in background) and broad, gently rolling, carpeted valleys characteristic of the Bonnet Lake Ecodistrict

Continuous cover of cottongrass tussocks and low shrubs on gently rolling to undulating pediment surfaces

2.20 WHITE MOUNTAINS ECODISTRICT



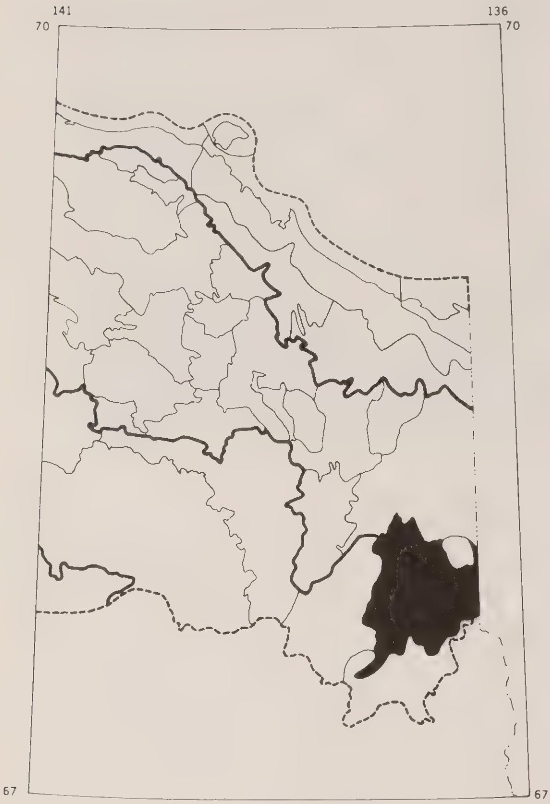
The White Mountains are the surface expression of Paleozoic limestones and dolomites which have been uplifted and tilted to their present high average elevation of 1,200 m above sea level. Erosion has created the highest local relief (876 m) of anywhere in the northern Yukon. On all sides the ecodistrict is bounded by faults; as a result, the brightly reflecting calcareous rocks contrast sharply with the dull browns of the surrounding Mesozoic clastic sediments. These transitions sometimes coincide with a stream bed, perhaps where differential erosion has acted along a fault plane. Elsewhere, the ecodistrict boundary may be perched on mid-slope. The bright reflectance and sharp edges of the White Mountains are clearly visible from space.

The White Mountains are similar in some ways to the British Mountains (2.04). Bedrock crags and pinnacles abound, with talus slopes covering most of the area. Valleys are narrow, V-shaped, and generally lack any floodplain or even fan development. The density of perennial streams is low, perhaps because the White Mountains Ecodistrict is small and runoff does not merge to create large rivers before leaving the unit. Also, the limestone fault-block probably allows a high percolation. The icing locations in the adjacent Bell River Ecodistrict (2.21) may receive some of their supply from the White Mountains.

In the White Mountains Ecodistrict, vegetation is limited to a very few small patches and stripes of alpine tundra on the lowermost portions of a few slopes. Dryas octopetala is probably the most common species.

The predominantly unvegetated and rugged White Mountains, with the sparsely to continuously vegetated Richardson Mountains in the foreground

2.21 BELL RIVER ECODISTRICT



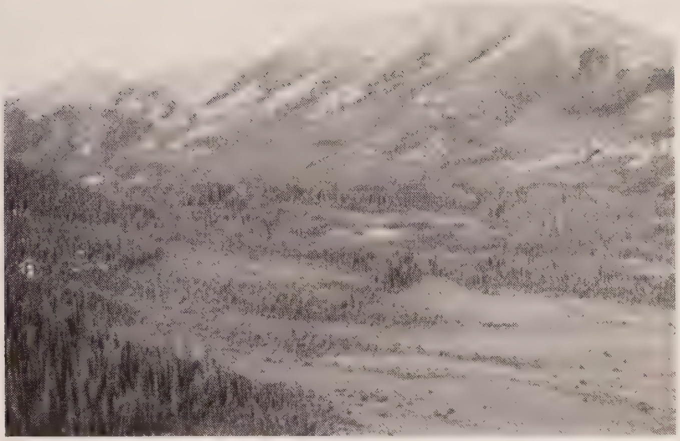
Within the Northern Mountains Ecoregion, the Bell River Ecodistrict is where the Richardson Mountains reach their fullest expression. These are angular mountains eroded from the folds of Cretaceous sandstones. Their average height of 948 m and local relief of 665 m puts them in the same topographic class as the British Mountains. Much of the landscape is of colluvium-covered slopes and valley bottoms covered with fluvial sediments. Where aspect is favourable, there is growth of spruce. The remainder is tundra-covered; there is little actual barren land. To the east, the Bell River Ecodistrict is bounded by the Northwest Territories border. At the northeast corner of the ecodistrict are to be found the prominent limestones of the White Mountains (2.20). On all remaining sides, the Bell River Ecodistrict borders onto areas of lesser relief -- mainly hills and mountains but in one case, Driftwood River (3.04), a plain.

The streams of this area, like all those of the Richardson Mountain shale and sandstone areas, display pH's under 6.5. Streamflow is highly seasonal and most headwaters are of the gravel-bed type. The large size of the area, however, means that many streams can merge to form substantial rivers before leaving the area. Usually these rivers are braided, some of which also have aufeis. The Bell River itself collects many of these braided streams, and so assumes a meandering form.

The mountainous Bell River Ecodistrict displays a striking transition in vegetation cover from north to south. In the northern part, upper portions of mountain slopes are largely bare of vegetation, middle portions have scattered clumps and stripes of alpine tundra, often scattered with Picea glauca, and basal portions of some slopes with southern exposure have open stands of Picea glauca. In the southern part of the ecodistrict, upper portions of slopes are largely bare (scattered Picea glauca and small patches or stripes may be present, particularly on slopes with a southern exposure), and middle and lower portions of slopes have open stands of Picea glauca or P. glauca along with Betula papyrifera. The density and size of trees are greater on slopes with a southern aspect.

Fans in the ecodistrict are largely tussock/low-to-medium shrub tundra, consisting of Eriophorum vaginatum along with Betula glandulosa (in the southern part) or B. nana (in the northern part), Ledum palustre ssp decumbens, Vaccinium vitis-idaea, Salix spp, Empetrum nigrum, and bryophytes. In the south, scattered, stunted Picea glauca are present.

Picea glauca lines the river and stream borders, forming open stands in the north and relatively dense stands in the south. Along many of the streams, other tree-size species include Populus balsamifera, Salix alaxensis, and S. arbusculoides, and understory species include Salix pulchra, S. glauca, and Alnus crispa. River and stream terraces are highly variable depending upon surface materials, but common species include Picea glauca, Salix alaxensis, other Salix spp, Vaccinium uliginosum, V. vitis-idaea, Empetrum nigrum, Ledum palustre ssp decumbens, Rubus chamaemorus, and bryophytes.

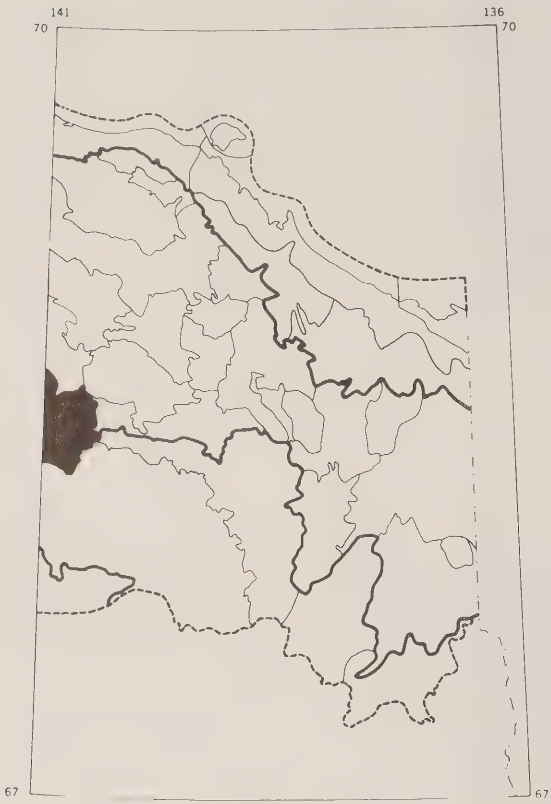


Colluvium-covered mountains and broad, U-shaped valleys, frequently occupied by wetlands, are typical of most of the Bell River Ecodistrict; white spruce lines stream borders; tundra or tundra with stunted white spruce occupies lower river terraces; open stands of white spruce/lichen along with some paper birch occupies middle and lower slopes; and upper surfaces are nearly barren to sparsely vegetated

Angular, colluvium-covered mountains of sedimentary bedrock in the northeastern portion of the ecodistrict; here, higher elevations are largely barren or sparsely vegetated, whereas middle and lower slopes have continuous or discontinuous cover of alpine tundra along with scattered white spruce

Open stands of white spruce/lichen and some paper birch are common on the colluvium-covered, drier, south-facing slopes of the Bell River Ecodistrict, especially in the southern portion

3.01 THOMAS CREEK ECODISTRICT



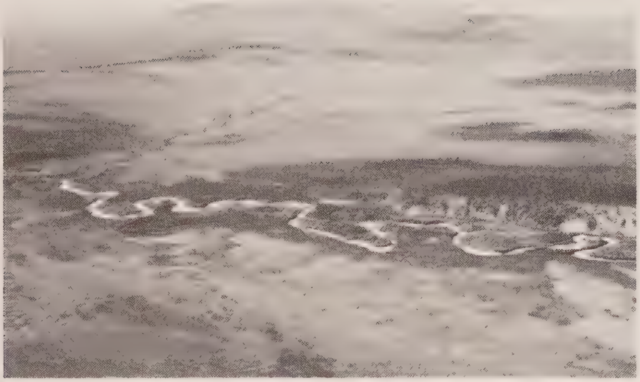
Within the study area (ie north of the Porcupine and Bell rivers), the Old Crow Basin Ecoregion forms an extensive lowland. Thomas Creek, in the northwestern part of the ecoregion, is a piedmont area that acts as a topographic transition from the Northern Mountains Ecoregion to the low-lying focus of the Old Crow Basin -- the Old Crow Flats (3.02). To the south of Thomas Creek, the Old Crow Flats themselves provide an abrupt change where pediments meet organic-covered lacustrine sediments. To the east is another piedmont area -- the Old Crow Pediments (3.03). The north and northeast edges of this ecodistrict are marked by an increase of elevation and relief to the Riggs Mountain (2.07) and Whitefold Hills (2.09). In the west, Thomas Creek extends into the United States.

Topographically, the Thomas Creek Ecodistrict is similar to the Bonnet Lake Ecodistrict (2.19). Hills and broad valleys dominate, covered mainly by colluvium, fans, and pediments. For the most part, the valley bottoms are very restricted in width. Only in the south are fluvial sediments of possible significance. In the southeast portion of this area are several square kilometers of deposits which may be eolian or wind-disturbed fluvial deposits. Logistical problems precluded a field visit to this area.

Also in the southeast are a few lakes, outliers of the Old Crow Flats (3.02), which are included in the Thomas Creek Ecodistrict because of extensions of terrestrial features such as the problematical fluvial deposits, pediments, and bedrock features.

Taiga -- open stands of largely _Picea glauca_ -- is the typical vegetation cover of the Thomas Creek Ecodistrict. Alpine tundra species (_Dryas octopetala_, _Arctostaphylos alpina_, _Salix reticulata_, etc.) likely form the understory on colluvium; tussocky terrain -- characterized by _Eriophorum vaginatum_, _Betula nana_ or _B. glandulosa_, _Ledum palustre_ ssp _decumbens_, _Vaccinium vitis-idaea_, _V. uliginosum_, and bryophytes -- probably forms the understory on fans and pediments.

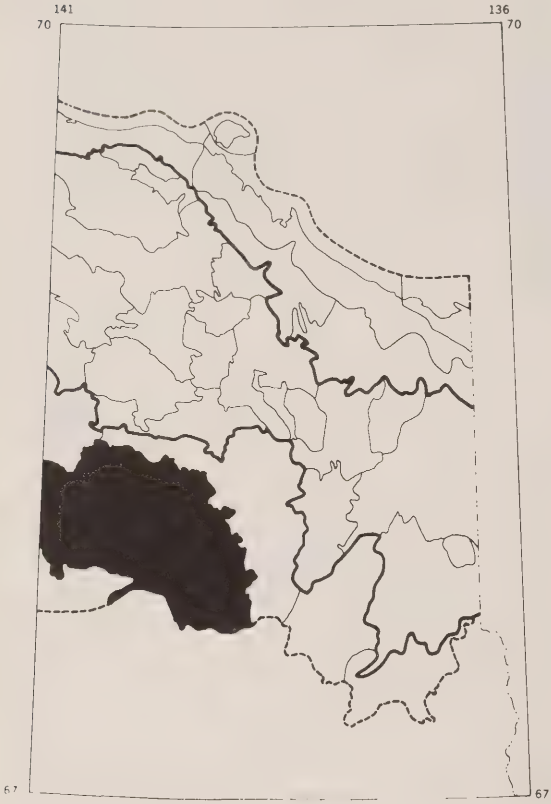
Stream channels are lined with _Picea glauca_ along with _Salix alaxensis_, other _Salix_ spp, and _Populus balsamifera_.



Low hills, broad valleys, and gently inclined pediment surfaces of the Thomas Creek Ecodistrict; sparse to discontinuous cover of alpine tundra on higher elevational summits, whereas continuous cover of cottongrass and low shrub tundra blankets pediments and valleys; feltleaf willow or feltleaf willow and white spruce are more restricted to areas along streams

Lower slopes or foothills with open stands of white spruce on the more favorable southern exposures (left foreground) and sparse to discontinuous cover of alpine tundra on other sites

3.02 OLD CROW FLATS ECODISTRICT



In pre-glacial times, the Old Crow Basin and surroundings drained southeastwards. During the Quaternary period, continental glaciers moving from the Mackenzie lowlands into the Richardson Mountains blocked the former drainage outlet of the Old Crow region. Initially, a number of pro-glacial lakes were formed, the main one occupying what is now the Old Crow Flats. These lakes eventually found a new collective outlet to the west, where erosion has since created an entrenched outlet and established the present Porcupine River.

The main consequence of these events has been to fill and level the lower parts of the Old Crow Basin with lacustrine clays. This area has very little local relief, and in that respect is comparable to the Komakuk Plains (1.01) despite widely differing past environments. Ironically, little of the glacio-lacustrine sediments now appear at the surface, as most are covered with a blanket of organic materials several meters thick.

Perhaps the outstanding property of the Old Crow Flats is the abundance of lakes -- lakes of all sizes but not of all shapes. They are dominantly squared, rectangular, or triangular. Groups of small, irregular lakes are, upon examination of aerial photographs, seen to be the remnants of earlier large, squared lakes which have become infilled with organic deposits. Most discussion on the origin of these singularly shaped lakes centers on combinations of prevailing wind directions, the controlling influence of patterned ground, and the erosional effect of wind-drifted lake ice on organic shorelines. Whatever the cause of their shapes, even less is known of their origin. One assumes them to be remnants of the former 3,100 km^2 of glacial lake. This, however, must be held open to question, since the lakes are mostly less than 2 m deep but on many meters of organic material. It is problematical whether undulation in the glacial lake bed would be directly responsible for the size and distribution of lakes today.

Although many of the lakes reach sizes of more than 250 ha, all lakes are exceedingly shallow. Secchi disc measurements of transparency, however, are usually between 0.75 and 1.0 m. The waters are thick with algae and, often, emergent vegetation. Diving ducks are a common sight. Although there is little throughflow in the lakes of the Old Crow Flats, these environmental signs point to a eutrophic state.

The dry terrain of the flats is of exceedingly level organic terrain. Local relief is determined by the height of shorelines, sometimes reaching 6 m. Shorelines are steep banks covered with willow; beaches are rare but, where present, are of fine, organic mud. Towards the western end, white spruce becomes an important vegetation cover. In these locales, moose are frequently sighted.

Stream channels are a rarity in the Old Crow Flats. Most drainage is by seepage through the organic materials, probably perched above the underlying glacio-lacustrine clays. The main rivers of the area are exotic streams, such as the Old Crow River and Johnson Creek, which rise on the hills and pediments surrounding the Old Crow Flats. These streams collect water from a relatively wide area, including seepage from the Old Crow Flats themselves. Coupled with the fine-grained unconsolidated nature of the sediments here, these rivers both meander and incise freely, so that all of the lakes of

the Flats can be considered as perched. Any disturbance of the terrain that leads to increases of surface runoff and erosion could have consequences apart from localized gullying. The lakes themselves could quickly be drained, thus destroying most valuable habitat for wildlife and natural resources for indigenous peoples.

The vegetation of the Old Crow Flats Ecoregion consists of a complex mixture of wetland, riparian, and aquatic community types along with tussock/medium shrub tundra communities in upland sites.

Lake and pond borders generally consist of Salix pulchra, other Salix spp, Betula glandulosa, Ledum palustre ssp decumbens, Vaccinium vitis-idaea, Rhododendron lapponicum, and Carex spp. A few scattered Picea glauca occur along some lakes and ponds in the southern part of the ecodistrict. The lakes and ponds themselves, particularly at their margins, contain a variety of submerged and emergent species, including Nuphar polysepalum and Hippuris vulgaris.

River and stream riparian communities are of two main types. The majority of rivers and streams are lined with riparian woods of Picea glauca, Salix alaxensis, Populus balsamifera, and sometimes Betula papyrifera, with understories largely of Betula glandulosa, Salix pulchra, other Salix spp, and bryophytes.

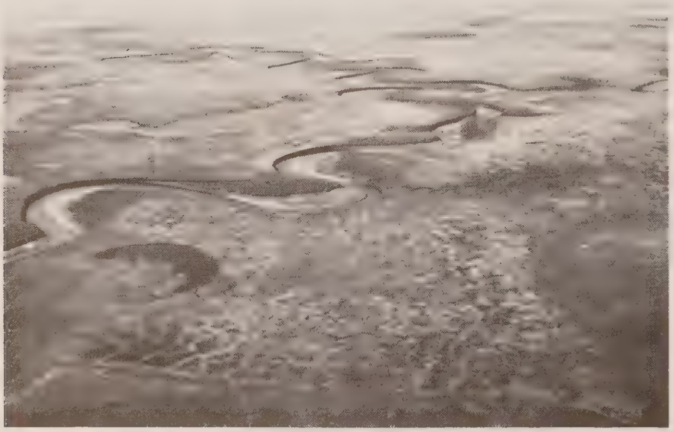
Many of the more recent alluvial terraces of the meandering rivers and streams, on the other hand, are characterized by very dense thickets of Salix alaxensis and other Salix spp.

Patterned ground or fenlands are common in many of the filled-in lake beds, and common species include Carex microchaeta, C. aquatilis, Sphagnum spp, and Polytrichum juniperinum.

Upland sites in the ecoregion are largely tussock and low shrub typified by Eriophorum vaginatum along with Ledum palustre ssp decumbens, Betula glandulosa, and Sphagnum spp.

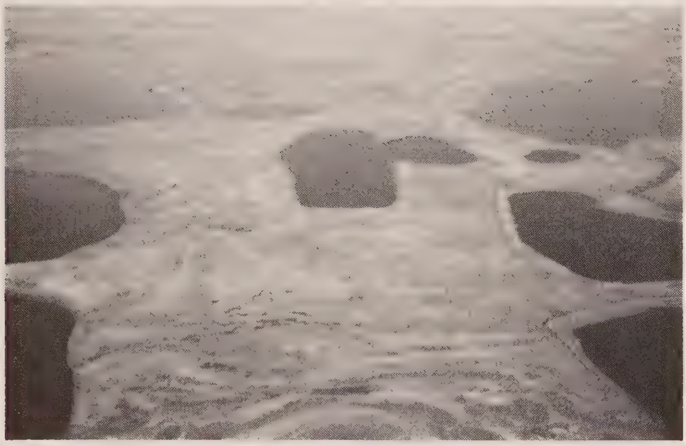
Markedly meandering rivers and irregular to often rectangular, shallow lakes of the Old Crow Flats; outlines of previous lake limits surround most lakes; white spruce, feltleaf willow, and balsam poplar line most stream channels; cottongrass and medium shrub tundra dominates on many upland sites, whereas white spruce taiga is common on many other sites

Extensive, undulating to nearly level plain dotted with shallow lakes and ponds, and dissected by numerous meandering streams; view north toward the foothills of the Northern Mountains Ecoregion



Meandering rivers and small, curved oxbow lakes along the Old Crow River; patterned ground (low and high center polygons) occurs in many wetlands, which are ubiquitous in the Old Crow Flats -- these wetlands are the largest extensive group in the northern Yukon

Peat fires are a common occurrence on the Old Crow Flats

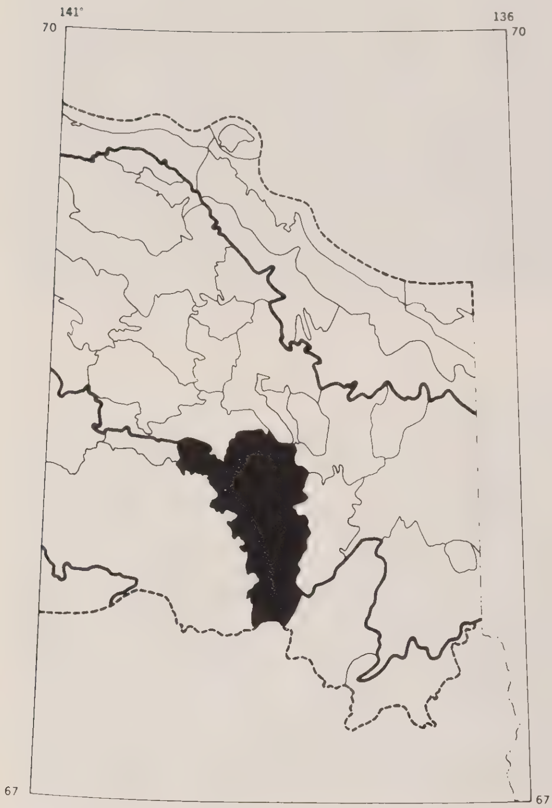


Angular shorelines of some lakes in the Old Crow Flats; shorelines receding as lakes are infilled with emergent aquatics (water lily, marestail, etc.) and sedges; cottongrass and low or medium shrub tundra on organic and infrequently lacustrine materials of inter-lake areas

Broadly meandering stream with coarse-textured floodplains; oxbows and scroll bars common along the stream; lush willow or willow-white spruce cover prevails on stream terraces

Several streams crossing the Old Crow Flats incise into fine-textured lacustrine sediments; dense willow thickets or willow and open white spruce stands occupy the recent scroll bars

3.03 OLD CROW PEDIMENTS ECODISTRICT



After the Old Crow Flats (3.02) themselves, the Old Crow Pediments form the second largest ecodistrict in the northern Yukon study area. As the name suggests, it is an area of pediments flanking the central part of the Old Crow Basin. This ecodistrict is in the shape of an irregular seven (7). Its south and west margins are clearly marked by the transition from silty dry-land pediments to organic, lake-studded flats. The outer (north and east) limits are where bedrock hills and mountains rise above the pediments. It is these rocky areas that provide the sediment supply for the pediments.

Where the Old Crow Pediments separate the Flats from calcareous hills and mountains, as along the northern side, the pediments are only 5 to 10 km wide. Where they lie next to clastic rock ecodistricts, however, the pediments extend from 20 to 45 km in width, measured downslope. This relationship demonstrates how a particular feature often depends on neighbouring units of land for its origin and maintenance.

The Northern Mountains were not glaciated in Quaternary times. No evidence has been reported for local glaciers or even nivation hollows. The youngest rocks of the entire area are Cretaceous. These observations, combined, imply that up to 68 million years have been available for the formation of the pediments. In fact, the existence of pediments is positive evidence against glaciation. They may, of course, be much younger, but until direct evidence is reported (such as dated drill cores), they must be considered a potential source of data on climatic and vegetational history throughout the Tertiary epoch. Their possible long history, silty soils, present day ubiquitous permafrost, tundra vegetation, and regional slopes of 5 to 31 m/km combine to class this ecodistrict, as with the Old Crow Flats to the west and south, as environmentally sensitive.

As with the Komakuk Plains (1.01), local relief is mainly a function of regional slope; the Old Crow Pediments are a tilted plane. The materials are mainly silty alluvium (pediment deposits), with organic debris accumulating in depressions and along seepage lines. The density of drainage channels is very low, although seepage lines marked by vegetation differences are numerous. These latter create distinctive 'feathered' drainage patterns. Where drainage channels do occur, they meander in regular forms. All drainage of pediments is environmentally important because it acts to transport water and nutrients to the Old Crow Flats, thus maintaining water levels and nutrient status beyond the time of spring runoff.

The Old Crow Pediments Ecodistrict is a very extensive area consisting mainly of alternating tussock/low-to-medium shrub tundra and heathlands. The tussocky area is characterized by Eriophorum vaginatum, Ledum palustre ssp decumbens, Betula glandulosa, widely scattered Picea glauca, and mosses. Empetrum nigrum, Vaccinium uliginosum, Arctostaphylos alpina, and Salix spp are also locally abundant on drier sites. Heathlands are typified by Alnus crispa, Salix spp, Vaccinium uliginosum, Ledum palustre ssp decumbens, and widely scattered Picea glauca. The gentle south-facing slopes along the northern border of the ecodistrict -- the foothills of the British Mountains and the Barn Range -- contain open stands of Picea glauca

which meld southwards into mixed tussock and heath communities.

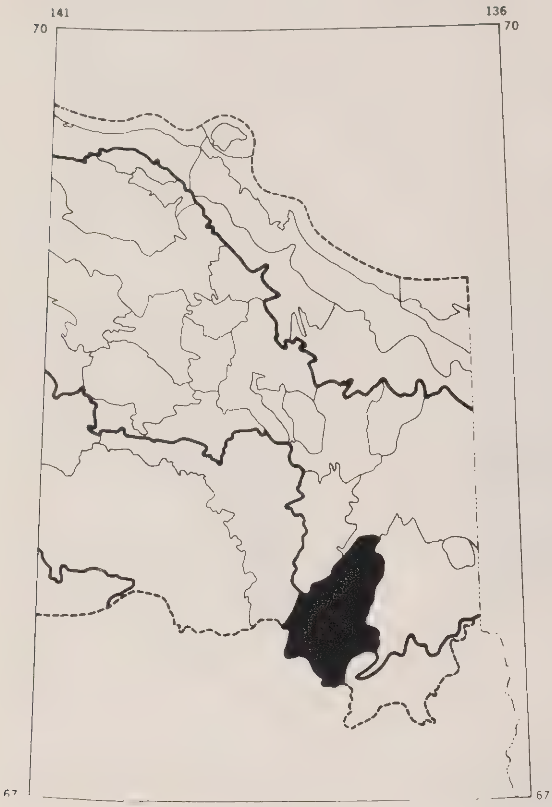
Streams are lined with Picea glauca or with Picea glauca, Salix alaxensis, and other Salix spp. Riparian woods become progressively denser as the streams approach the Old Crow Flats Ecodistrict (3.02), and near this ecodistrict Populus balsamifera and Betula papyrifera may be present. Gravel bars are typified by Salix alaxensis and other Salix spp or by Salix alaxensis, other Salix spp, and Populus balsamifera, both situations giving way to Picea-dominated riparian woods farther from the streams. Away from the streams, the riparian woods give way to open Picea glauca stands and then to tussock tundra or heathlands.

Drainageways are generally lined with Salix spp.

In foreground, gently inclined planar surface of the Old Crow Pediments Ecodistrict with continuous ground cover of sedge tussocks along with low to medium shrubs; in background, low, colluvium-covered hills of the Whitefold Hills Ecodistrict

Continuous cover of cottongrass and low shrub tundra along with scattered, stunted white spruce

3.04 DRIFTWOOD RIVER ECODISTRICT



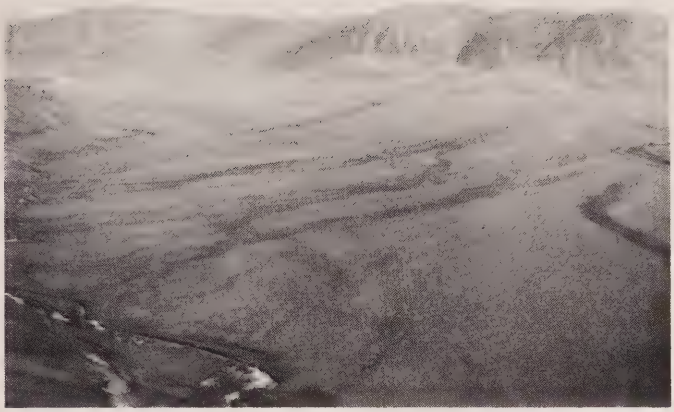
In many ways, the Driftwood River Ecodistrict is a continuation of the Old Crow Pediments Ecodistrict (3.03). Whereas the latter is essentially a sloping plain of uninterrupted pediments, the Driftwood River area has more local relief due to the emergence of bedrock structures. There are also close parallels with the Bonnet Lake Ecodistrict (2.19) to the north. Bonnet Lake differs in being hillier and treeless, whereas river valleys offer sites for white spruce in this ecodistrict.

The Driftwood River Ecodistrict is triangular in shape, its axis being oriented northeast-southwest. The southwest side, or base, of this triangle is the Porcupine River, the southern limit here of the study area. Along the northwestern side of the ecodistrict, the border is more or less a transition to the similar Old Crow Pediments and Bonnet Lake ecodistricts (3.03 and 2.19). Most of the eastern edge of the ecodistrict is clearly marked by the front of the Richardson Mountains (Bell River Ecodistrict, 2.21). The southern portion of this side is another transition, this time to the Waters River (3.05) area.

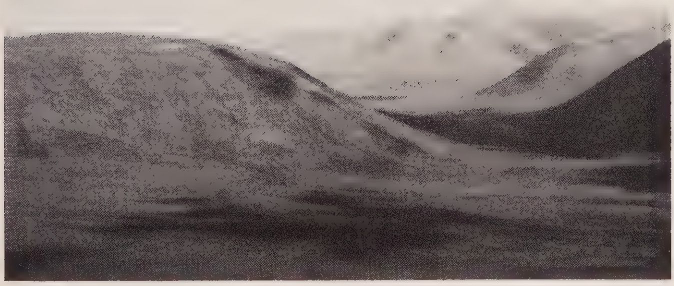
The ecodistrict consists largely of pediments and residual materials with fluvial materials covering the floodplains of meandering rivers. The density of drainage channels is low, as is the pH of the waters.

The predominant vegetation type of the Driftwood River Ecodistrict is tussock/low-to-medium shrub tundra characterized by tussocks of Eriophorum vaginatum and a low shrub layer mainly of Betula glandulosa, Salix spp, and Ledum palustre ssp decumbens along with lesser amounts of Vaccinium uliginosum, V. vitis-idaea, Arctostaphylos alpina, Empetrum nigrum, Rubus chamaemorus, and mosses.

Streams are primarily lined with Salix alaxensis and other Salix spp. Scattered Picea glauca also occur along streams in the central portion of the ecodistrict. In the southern portion, fairly dense riparian woods of Picea glauca occur, often with Populus balsamifera and Salix spp as codominants. Coarse-textured floodplains are typified by thickets of Salix alaxensis and other Salix spp. Drainageways are largely Carex aquatilis, Salix pulchra, other Salix spp, and Eriophorum angustifolium along with Betula glandulosa, Potentilla palustris, and Sphagnum spp.

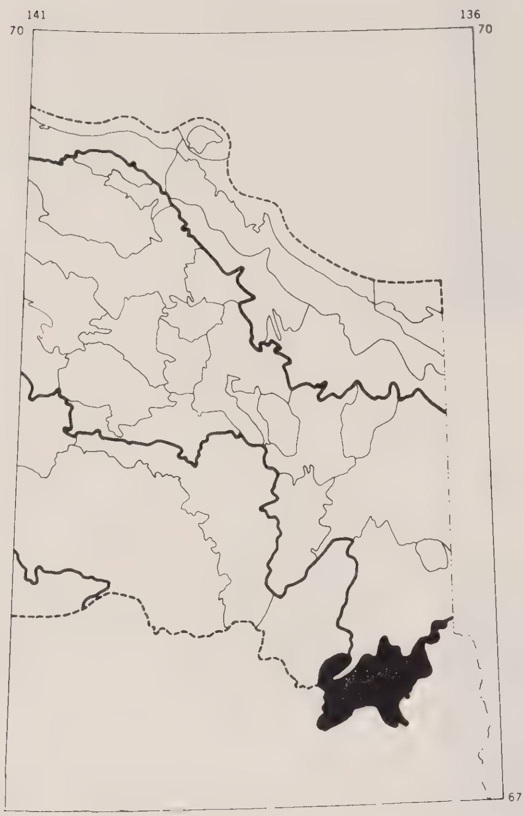


In foreground, extensive and gently inclined pediment with continuous cover of cottongrass tussocks and low to medium shrubs; willow thickets and sedges dominate the feather-textured drainageways, and feltleaf willow and other willows line the stream channels; in background, colluvium-covered hills and mountains of the Bell River Ecodistrict



Low, rounded, sparsely vegetated hills, broad, U-shaped valleys, and extensive pediment surfaces with a continuous cover of cottongrass tussocks, low to medium shrubs, and scattered, stunted white spruce; angular mountains and hills of the Bell River Ecodistrict in background

3.05 WATERS RIVER ECODISTRICT



This is an ecodistrict of hills of Cretaceous shales and sandstones. Topographically, they are connected northwards to the Richardson Mountains (Bell River Ecodistrict, 2.21), for which they act as foothills. Most of the Waters River area is bounded by the lower Bell River and a portion of the Porcupine River. Along the northern limits, the Richardson Mountains rise progressively higher, thus forming a somewhat transitional boundary.

The terrain of this ecodistrict is relatively complex. Residual and colluvial surfaces dominate, with bedrock, floodplain, and pediment deposits being less frequent.

The Waters River Ecodistrict is the most heavily treed of all ecodistricts in the northern Yukon study area. Although the low, rounded hills of the northern portion of the ecodistrict (the foothills of the Richardson Mountains) are characterized by alpine tundra (patches and stripes on the middle and upper slopes and broader expanses on the lower slopes), most of the remainder of the ecodistrict has arboreal communities, the composition of which seems to depend heavily on aspect and drainage conditions. Slopes with a southern aspect generally have fairly dense stands of Picea glauca along with Betula papyrifera, Vaccinium vitis-idaea, Empetrum nigrum, and mats of ground lichens, particularly Stereocaulon tomentosum, Cladina stellaris, C. mitis, and C. rangiferina. Slopes with a northern exposure are typified by more open stands of Picea glauca as well as Betula glandulosa, Ledum palustre ssp groenlandicum (up to 30 cm in height), Vaccinium vitis-idaea, Alnus crispa, and Sphagnum spp. Eriophorum vaginatum is abundant near the base of north-facing slopes. Stands become progressively more open with increase in elevation for both north- and south-facing slopes, and the uppermost portions have only a few scattered Picea glauca or are bare. Pediments and fans consist largely of tundra typified by tussosks of Eriophorum vaginatum and low shrubs such as Betula glandulosa, Ledum palustre ssp groenlandicum, Vaccinium vitis-idaea, and Salix spp. Widely spaced and stunted Picea glauca may also be present.

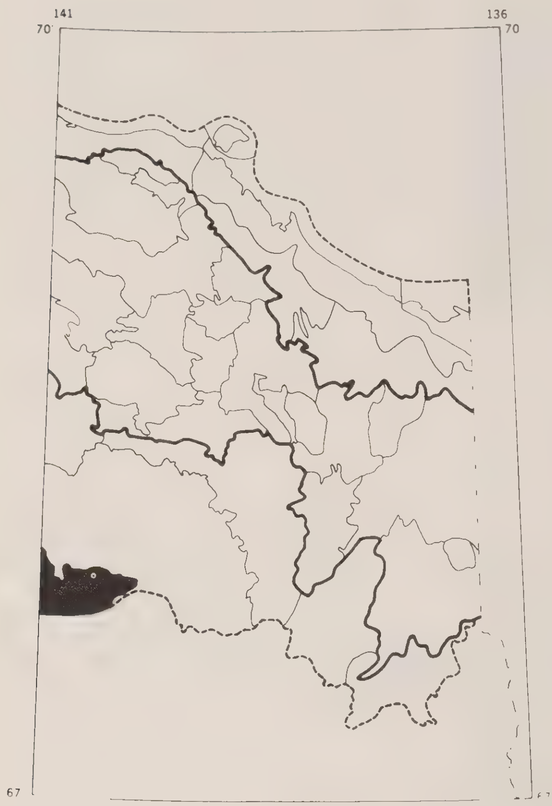
Streams are lined with riparian woods of Picea glauca or of P. glauca and Populus balsamifera along with Salix pulchra and other Salix spp. Coarse-textured floodplains are characterized by stands or thickets of Populus balsamifera and Salix spp, although many are also lined with scattered Picea glauca.

Rounded to angular, colluvium-covered hills and broad, gently inclined pediment surfaces; open stands of white spruce/lichen or white spruce/moss common on lower hill slopes, cottongrass tussocks along with low to medium shrubs and scattered, stunted white spruce on pediments and terraces, and feltleaf willow, other willows, and white spruce along stream channels

Open stands of white spruce/moss and white spruce/lichen on colluvium-covered lower hill slopes of the Waters River Ecodistrict; tussocks of cottongrass along with low to medium shrubs and stunted white spruce throughout the valley floor, and feltleaf willow, other willows, and white spruce along stream channels

In foreground, stunted white spruce and thickets of medium-height willows along a stream; in background, open to closed stands of white spruce along with paper birch on low, rounded, colluvium-covered hills

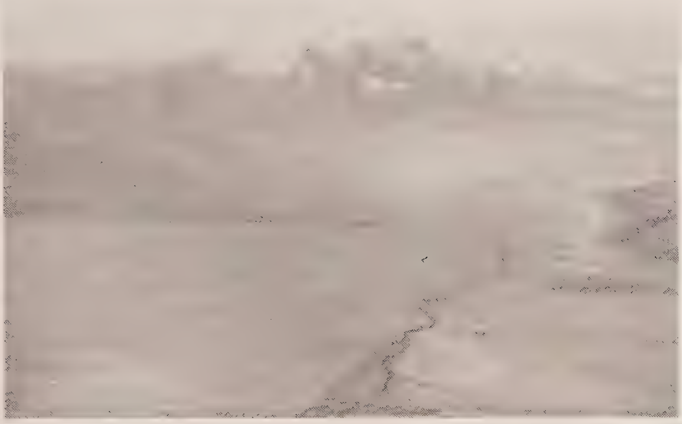
4.01 OLD CROW RANGE ECODISTRICT



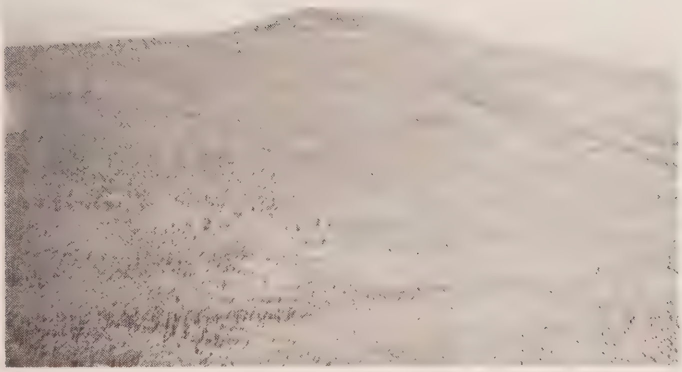
In its southwest corner, the survey area overlaps into the North Ogilvie Mountains Ecoregion, which is here represented by part of a single ecodistrict, the Old Crow Range. This range is composed of hills of Precambrian granitic rocks, much more subdued than areas of similar rocks to the north, such as the Malcolm River (2.03) and British Mountains (2.04) ecodistricts.

Colluvium accounts for most of the Old Crow Range surfaces; most of this moves by solifluction rather than by free fall. A characteristic feature of these hills is the widespread occurrence of tors on the summits. These are yet another eloquent statement of a non-glacial history. Tors are widely accepted as a periglacial denudation feature, often coupled with a previous history of tropical or sub-tropical deep weathering. On the lower slopes are fans and pediments. Meandering streams occupy the valley bottoms.

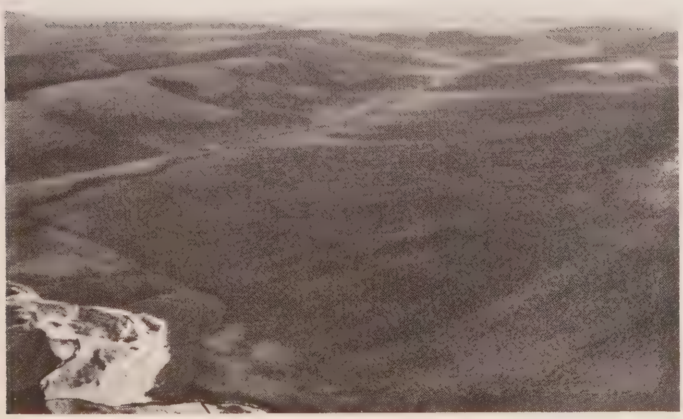
Rolling hills and slopes at lower elevations, near the Old Crow Flats particularly, have Eriophorum vaginatum tussocks with associated Ledum palustre ssp decumbens, Betula nana, Vaccinium vitis-idaea, Aulacomnium sp, Hylocomium splendens, and scattered ground lichens. Picea glauca is also present, but the stands are very open and stunted. Upper slopes are characterized largely by Dryas integrifolia, low Salix spp, and lichens, especially Cetraria cucullata. Ridge tops are largely vegetated with Dryas integrifolia and low Salix spp, but polygons and large patches of exposed angular fragments are common. Tors are almost entirely unvegetated. Streams are lined with Salix spp and/or Picea glauca, and some lowlands and southern exposures of some slopes have scattered Picea glauca along with low Salix spp and Betula glandulosa. Lowlands near the Porcupine and Old Crow rivers have Picea glauca or P. mariana, Salix pulchra, Vaccinium uliginosum, and Betula glandulosa.



Foothills surrounding the base of the Old Crow Range are commonly separated by broad valleys; cottongrass tussocks and low to medium shrubs along with scattered, stunted white spruce cover the valleys



Open stands of white spruce grading downslope into cottongrass tussock and low shrub tundra; summit bedrock exposures often provide areas for tor development



Open stands of white spruce with an understory of cottongrass tussocks, low to medium shrubs, and mosses on rolling hills; sparse tundra covers many hilltops; feltleaf willow, other willows, and scattered spruce occur along stream margins

SECTION E

STANDARDS FOR DESCRIPTION

INTRODUCTION

The conventions or standards employed on the ecodistrict map and in the descriptive text are discussed in this section. The legend accompanying the map has a twofold purpose. The coloured front face of the map has a short, general descriptive legend. The back side has a more technical presentation. The notations used are largely numerical as this technical legend was principally designed to allow for the ease of computer entry. The terms used in the descriptive text were, for communications, drawn from national systems where they existed (eg the National Soil Classification System for Canada). In certain cases, standardized national systems didn't exist and they had to be totally derived, or modified from systems in regional use.

The technical legend for the ecodistricts is outlined in the remaining part of this section. Within this, the individual systems used for describing topography, landforms, soils, etc. are defined.

TECHNICAL MAP LEGEND

Each ecodistrict is identified by a three-digit number (Table E1). The first digit refers to the ecoregion; the others indicate the ecodistrict within that ecoregion.

Ecoregion   Ecodistrict

1.01

For each ecodistrict identified, the location, area, number of ground truthing sites, and the biological and physical land characteristics have been numerically coded in the map's legend. While the map of ecodistricts has this code briefly explained, it is amplified here in the following.

LOCATION

The centroid of each ecodistrict mapped is indicated in the first four columns. Degrees north are all in the 60's; only the last digit is stored. The second character is the 10's of minutes. Third comes the last number of the degrees west. The range is 136°W to 141°W, so no ambiguities arise. Finally, the 10's of minutes west are written. For example, the East Barn Range is centered on 68°30'N, 138° 10'W. It is coded as 8381.

AREA

Following the locater number is the ecodistrict area. This was measured by planimeter on 1:500,000 maps, and is stored in square kilometers. As an example, the East Barn Range measures 312 km^2. Its code so far reads 0312.

GROUND TRUTHING SITES

The number in this column shows the number of field stops within the ecodistrict. For example, Komakuk Plains had one landing site to check characteristics interpreted from LANDSAT and aerial photographs. Thus, the number '1' is noted.

TOPOGRAPHY

Topography includes aspects related to average elevation and local relief. These are indicated under the first two columns with the overall caption of 'Landforms and Soils'.

<u>Average Elevation</u> was measured from 1:250,000 topographic maps. Twenty kilometer grid squares on these maps were used as a sampling net. Within each square, or portion of a square of at least the length of one side, the highest and lowest points were estimated from contours and benchmarks. Average summit and valley heights were calculated. The difference yields a <u>Local Relief</u> value, and the midpoint gives a measure of average elevation. This method is fast and yielded results with which our impressions of Regional Landforms were compatible. Average generalizations, local relief especially, tend to change inversely with the scale of perception, since this method maximizes differences in a given area.

Average elevation and local relief are, of course, strongly and positively correlated (Figure E1). Only once does the local relief value exceed that of average elevation. This is for the Mount Conybeare Ecodistrict (2.01), a range of hills close to the Arctic coast. In general, Mountains (landform classes 0 and 1), Hills (classes 2 to 5), and Plains (classes 6 and 7) discriminate well. One overlap occurs within the Timber Creek Ecodistrict (2.08), a rolling plain of pediments but with isolated, sinuous, bedrock ridges rising through the surface. Only by comparison with other 'hilly' areas does its plainness become clear. The method of measuring local relief, however, tends to pick out the few ridge-tops and the long, gentle slopes of pediments.

Table E1: Numerical index to ecodistricts

ECOREGIONS	Northern Coastal Plain	Northern Mountains	Old Crow Basin	North Ogilvie Mountains
ECODISTRICTS	1.01 Komakuk Plains 1.02 Herschel Island 1.03 King Plains 1.04 Shoalwater Bay 1.05 Babbage Plains 1.06 Running River	2.01 Mount Conybeare 2.02 Buckland Basin 2.03 Malcolm River 2.04 British Mountains 2.05 Joe Creek 2.06 Upper Trail River 2.07 Riggs Mountain 2.08 Timber Creek 2.09 Whitefold Hills 2.10 East Barn Range 2.11 West Barn Range 2.12 Blackfold Hills 2.13 Cottonwood Creek 2.14 Mount Sedgwick 2.15 Tulugaq Pediments 2.16 Blow Pass 2.17 Purkis Creek 2.18 Richardson Folds 2.19 Bonnet Lake 2.20 White Mountains 2.21 Bell River	3.01 Thomas Creek 3.02 Old Crow Flats 3.03 Old Crow Pediments 3.04 Driftwood River 3.05 Waters River	4.01 Old Crow Range

REGIONAL LANDFORMS

Regional landform classes are included to aid interpretation of the remaining data. They are subjective assessments of the aerial photographs and our colour slides. In effect, they summarize many of the other descriptors. Despite (or perhaps even because of) their informal nature, we felt that these classes are useful to lend feeling to the various landscapes we encountered.

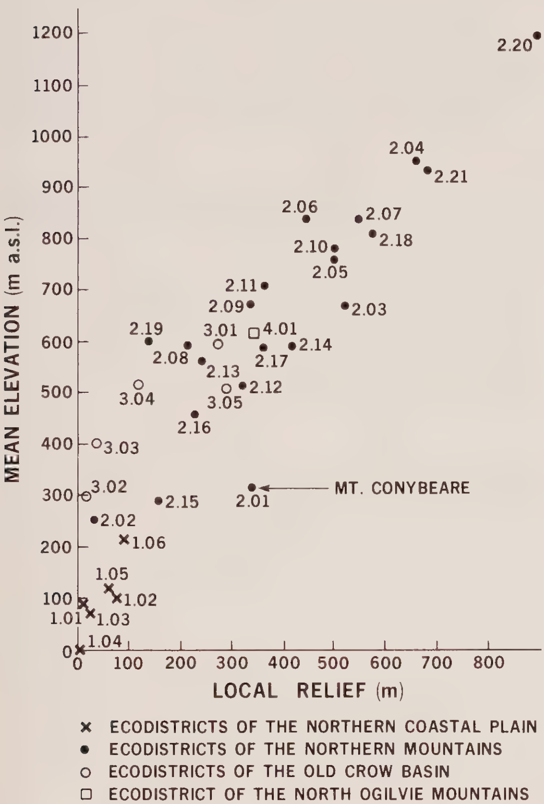
We have not tried to define precisely hills versus mountains, level versus rolling, etc. If objective data are wanted, they are contained in the elevation and local relief categories. The area perceived as mountainous transpires to have average elevations over 550 m above sea level and a local relief of 350 m or more. Angular mountainous areas have frequent rocky crags, pinnacles, and tors. Rounded mountainous areas have fewer bedrock outcrops; instead, their summits carry a greater extent of residual deposits such as felsenmeer or stony soils.

Between extremes of mountains and plains are classes of hills, ridges, hills with broad valleys, and ridges with broad valleys. All hills and ridges, with or without broad valleys, have average elevation of 300 to 700 m above sea level and local relief between 130 and 350 m. Hills and ridges are distinguished by the absence or presence of linear or sinuous bedrock features as topographic controls. Both tend to rounded summits covered by residuum. A notable exception is the Old Crow Range (4.01) where prominent tors present a distinctive skyline of gentle slopes capped with 'saw-teeth' and jagged crags.

Broad valleys are rolling lowlands spanning several kilometers between ridges or hills. Seen from the ground, these landscapes take on the appearance of rolling plains. Only from airborne or space-borne platforms do the uplands become readily apparent.

Plains are areas of low relief. In the northern Yukon, ecodistricts recognized as plains have less than 200 m relief. These

Figure E1: Ratio of mean elevation and local relief for ecodistricts



relief differences are measured over several kilometers, and so extensive plane but tilted surfaces, such as the Komakuk Plains (1.01) or Timber Creek (2.08) ecodistricts, assume the guise of pronounced relief. However, these plains have local relief of less than 30 m (rolling plains) and commonly even less than 2 m (level plains) as on the modern Mackenzie Delta (Shoalwater Bay, 1.04), the Old Crow Flats (3.02), and many pediment surfaces.

LOCAL LANDFORMS

Local landforms are subdivisions or component elements of regional landforms. This particular level of landform generalization is most appropriate for ecosections; however, because ecosections are not treated throughout the study area, they are documented within the ecodistrict map legend. Only the primary (1°), secondary (2°), and tertiary (3°) occurrences of local landforms are noted. These qualifiers have no direct correlation with percentage of ground cover. Thus, a primary landform could cover 80% of an area or it could cover only 50% of the area. In each case, the secondary and tertiary landforms would occupy less of the ground surface. There is no attempt at quantification, since this would require highly detailed mapping and planimetering. In a few instances, only two classes were present, or else the second class was miniscule compared to the primary one. For this, a None or Not Applicable (N/A) class (9) was introduced. For example, in the Buckland Basin (2.02), the landscape is of extensive pediments (class 2) with a few stream beds (class 3), and nothing else. The coding for this is 293.

An important consideration in interpreting this materials classification is that environmental importance does not necessarily follow percentage occurrence. For example, although usually limited spatially, fluvial environments are crucial for their support of rich vegetation, for water supply to wildlife, and for ease of movement to men and animals. Similarly, although rock outcrops are useful to raptors, their importance does not follow increases in number, since populations are limited by the resources of the food chain below them, both figuratively and literally.

Genetic Materials

Our classification of materials is founded upon the system developed in British Columbia and by the Geological Survey of Canada. It uses names which conjure up the geomorphic origins of land surfaces. The classes, therefore, combine interpretations of process with observations of form, thickness, and type of material.

In our use of the classification, Bedrock means solid, unweathered rock exposed to the sky. Although rock outcrops are common throughout the uplands of the northern Yukon, the area of exposed bedrock, defined in this way, is actually quite small. This does not, however, preclude its importance scenically, as in the British Mountains (2.04), scientifically, as in the Old Crow Range (4.01), or ornithologically, as when falcons seek steep rock cliffs for their homes. Blockfields (felsenmeer) are any considerable area, usually fairly level or of only gentle slope, which is covered with moderate-size or large blocks of rock that have been derived from the underlying bedrock by frost-shattering.

Residuum and Colluvium tend both to be composed of rock fragments and interstitial fines. Talus slopes, developing due to free-fall from

cliffs, are easy to recognize. On the ground, residuum and solifluction deposits grade into one another over gentle, convex changes in slope, coupled with increases in surface irregularity and, sometimes, lineations in vegetation cover. When interpreting aerial photographs at the ecodistrict level, however, it is hard to make these distinctions consistently. Because of this and their textural similarity, we have occasionally combined residuum and colluvium into a single category.

Pediments can imply surface form as well as genetic origin. The name refers to the smooth slopes which are usually formed at the foot of mountains or hills; the process of formation is associated with arid or semi-arid climates and involves downslope erosion and deposition by ephemeral drainageways. The upper portion of a pediment slope in the Yukon typically consists of bedrock or residuum; the lower and mid sections have a veneer or blanket of transported soil -- this is commonly called the Bajada. To emphasize the bajada-dominated pediments, the terms were used in conjunction under genetic materials.

In a similar way, Fans grade imperceptibly into pediments. In fact, a pediment is an overgrown fan, unconstrained by an opposing side to a valley. Their mode of formation is similar; both present smooth, concave slopes composed of sandy to silty sediments. Due to their similarity of materials, moisture supply, and vegetation, they too have been condensed into a single class of materials.

Fluvial deposits are the silt and sand, or sand and gravel, of channel beds and bars, islands, and floodplains. They also include the braided fans of the Firth and Malcolm rivers, as they emerge from the confines of the Northern Mountains Ecoregion and spread across the Komakuk Plains (1.01).

Organic materials are described wherever they blanket contemporary land surfaces. Organic accumulations mask the marine sediments of the Komakuk Plains (1.01) and the glacio-lacustrine clays of the Old Crow Flats (3.02). Thus, these latter, although widely reported on surficial geology of the area, are not recorded by us as parent materials. Within the context of an ecological land survey, we are more concerned with those properties that affect vegetation, wildlife, trafficability, sensitivity, hydrology, etc.

Moraine is described wherever ice was responsible for the final emplacement of debris. Moraine is restricted to the Northern Coastal Plain Ecoregion east of the Firth River. Its landforms are rolling plains, wherein depressions are filled with remnant lakes, lacustrine deposits, and organic blankets.

The deposits of Herschel Island (1.02) and on top of Engigstciak, a small hill in the Buckland Basin Ecodistrict (2.02), are Marine. Their textures and fossil contents still speak of their prior marine environment.

Lacustrine materials at the surface are now only encountered with any frequency where lakes have narrow beaches or mudflats. With its maze of lakes, the Old Crow Flats (3.02) is the only area for which we have included sediments at the ecodistrict level. Here, the beaches and flats are of organic ooze, little disturbed by wave action, and so do not resemble the usual notions of littoral sediments.

Surface Expression

Surface expression covers modifiers which are used to convey the form of genetic materials. Eight modifiers were employed in this report.

Steep refers to inclined (commonly greater than 35°) erosional slopes. It is used mainly to describe crags and ridgelines in mountainous terrain.

Fan, as a form, is self-explanatory. However, it is not meant to convey a flat but rather a slightly curved surface having a perceptible gradient from the apex to the toe. This modifier has been applied mainly to colluvial and residual materials.

Apron is a relatively gentle slope which occurs at the foot of a steeper slope. The materials which comprise the apron are derived from the steeper, upper slopes. Pediments and bajadas are the materials to which this modifier applies.

Level refers to a flat or very gently sloping, unidirectional surface. Slopes are generally less than 1.5°. It is used for large deltaic deposits near Komakuk Beach. Here, the surface is fairly constant at a low angle of inclination. The slope is not broken by marked relief. For similar terrain in which the slopes reach 3.0°, the term Horizontal was employed.

Inclined refers to a sloping, unidirectional surface with a generally constant slope not broken by marked irregularities. Slopes are 1.0° to 35°. The form of inclined slopes is not related to the initial mode of origin of the underlying material.

Rolling is used in conjunction with the till (moraine) plain within the Northern Coastal Plain Ecoregion. Here, the gently sloping sag-and-swell topography produces a wavelike pattern. Relief is moderate and gradients usually exceed 3.0°.

Terraced describes a step-like topography. The river or stream terraces are typical of this modifier.

Slumps are bowl-shaped areas which have debris accumulating in the lower positions of the basin.

Modifying Process

While the geological processes are often implied from the genetic materials, this modifier provides a more explicit description. It covers past and currently active processes.

Cryoturbated was employed for those unconsolidated materials which show evidence of frost-churning. As such, it applies to areas having patterned ground (eg polygons, unsorted circles, sorted nets, rock streams, earth hummocks, etc.).

Channelled surfaces include active and inactive braided streams, meander scars, and scroll patterns. These forms are seldom deeply incised.

Mass Wasting mainly concerns colluvium. The slopes are usually characterized by slow, downslope movement of debris from upper positions.

Frost-Shattered is used primarily for rocky surfaces covered with angular fragments. Large areas of this are termed blockfields or felsenmeers. The rock fragments are derived in situ by frost-shattering.

Depth and Permafrost

Unconsolidated materials are, in terms of depth, noted as veneers or blankets. The latter indicates materials which exceed 1 m. Upon these two depth indicators, we have superimposed the active layer (depth of thaw) as observed during field investigations. Three ranges appeared appropriate: less than 30 cm, 30 to 60 cm, and greater than 60 cm.

Texture

Seven textural modifiers are noted. For mineral materials, they indicate particle-size, shape, and degree of sorting; for organic materials, they suggest the origin and degree of decomposition.

Blocky refers to angular debris. The rocky material has particles which exceed 256 mm in diameter. Rubbly also refers to angular debris. The average diameter corresponds to a range of 2 to 256 mm.

Gravelly includes particles ranging in size from pebbles to boulders.

Clay and Silt are used as a composite textural modifier. This covers particles within the fine earth fraction.

Diamicton is a heterogeneous mixture of particles. The matrix consists of angular fragments which are infilled with silts and clays.

Fibrous organic material is readily identifiable. Mesic, by contrast, represents an intermediate stage of decomposition where the botanical debris is somewhat less identifiable as to origin. Both fibrous and mesic modifiers exclude organic material which contains more than 50% of woody fibers.

Free Water

Most soils have permafrost near the surface. This acts to impede vertical drainage and to promote near-surface lateral flow. Depending on the nature of the water source, the topography, and the texture of the soil, free water is retained in the active or thaw layer for different periods of time. The four free water classes reflect the degree and time which this free water is held.

Reaction

Reaction refers to the acidity or alkalinity of unconsolidated sediments. Measurements were taken within the active layer. The reaction was taken using a calcium chloride solution.

SOILS

Soils were classified according to the Canadian system as outlined by the Canada Soil Survey Committee. The mineral and organic soils of the study area fall almost entirely within the Cryosolic Order. However, with the very short field stops, we were unable to excavate holes to a depth that would reliably indicate the degree of cryoturbation. As such, the mineral soils are not specified as to whether they are turbic or static. Other studies and the patterned ground features suggest that the turbic label is the most appropriate.

VEGETATION

For vegetation, plant regions and plant districts were used in ecodistrict differentiation. Plant associations are also noted, but these and the plant districts are more useful at the ecosection level. Throughout we stressed recording species, abundance, structure, and pattern of the present cover. As with the other components considered, these serve as indicators of present, future, or past conditions.

Plant Region

A plant region is a botanical grouping which shows commonalities via abundance, structure, pattern, and floristics. This level of generalization usually reflects the influence of the macro or large meso scale climatic influences. Two examples include the Alpine Tundra and the Taiga groupings.

Cover and species composition of Alpine Tundra are highly variable, depending mainly on elevation, slope, aspect, and the type of rock. Cover is greatest on the toe slopes, where slopes are gentler. Here, surface materials are more weathered and more stable (less downslope movement of debris), and water is more available. Toe slopes usually have a complete (or nearly complete) vegetation cover composed largely of Dryas octopetala, D. integrifolia, Cassiope tetragona, Empetrum nigrum, Vaccinium uliginosum, Arctostaphylos alpina, Betula nana, Salix reticulata, and other Salix spp along with Carex spp, Lupinus arcticus, Hierochloe alpina, Pedicularis spp, and scattered ground lichens. Rocks (non-sorted circles, outcrops, etc.) generally have crustose lichens.

Ridge tops usually have a very sparse cover, predominately of Dryas octopetala along with Saxifraga tricuspidata, S. oppositifolia, other Saxifraga spp, Salix reticulata, S. phlebophylla, Carex spp, Arctostaphylos alpina, Hierochloë alpina, and scattered ground lichens. Papaver spp, Pedicularis spp, Draba spp, Silene acaulis, Antennaria spp, Potentilla uniflora, and Poa alpina are widespread but very sparse.

Taiga, the open, largely coniferous forest adjacent to the arctic or alpine tundra, is widespread in the southern parts of the study area and on south-facing slopes and along rivers in the northwestern part of the study area. Picea glauca is the most common tree species, although it may be accompanied by Betula papyrifera in some dry sites or by Populus balsamifera along some rivers (eg the Firth, Waters, and Bell rivers). Other species occurring depend on the vegetation communities adjacent to the taiga -- Eriophorum vaginatum, Ledum palustre ssp decumbens, Vaccinium vitis-idaea, Betula nana, etc. on tussock tundra; Dryas octopetala, D. integrifolia, Arctostaphylos alpina, Salix reticulata, etc. near alpine tundra; Salix spp and Betula glandulosa near streams; etc. The study area does not have any real examples of boreal forest, although parts of the Waters River Ecodistrict (3.05) do have relatively high covers (up to 60%) of trees, particularly on south-facing slopes. Picea glauca is the main species, and Betula papyrifera may be scattered throughout. The understory consists largely of ground lichens (especially Stereocaulon tomentosum, Cladina stellanis, C. mitis, and C. rangiferina) along with Vaccinium vitis-idaea and other low shrubs.

Plant District

A plant district is an element or subdivision of a plant region; this grouping is in turn composed of plant associations. With plant districts, the abundance, pattern, and floristics again play a role in separating units. They are, however, less general than the plant regions.

Examples of plant districts are tussock/trailing heath tundra and tussock/dwarf heath tundra. Each botanical grouping belongs to the Arctic Tundra plant region. The descriptions of these plant districts as well as the others are contained within the ecodistrict descriptions.

WATER

Lake Cover and Size

Lakes are by no means ubiquitous throughout the whole northern Yukon. Even where present in small measure, however, they are important and appealing components of a landscape. The King Plains (1.03) and the Old Crow Flats (3.02) ecodistricts are, in contrast with the majority of the northern Yukon, studded with lakes.

For each ecodistrict, we have recorded the percent of area covered by lakes. Cover classes are designed to indicate the confidence felt in estimating percentages from aerial photographs and 1:250,000 maps. Lake size is classed according to the lakes that contribute most of the area's water surface. Caution is necessary in interpreting this parameter, since wide variance is the rule rather than the exception where lakes are frequent upon the landscape. For want of a float-equipped helicopter, we could not obtain much systematic lake data:

general observations are discussed with each ecodistrict. At most of our field stops, pH was measured at lake-side or in a stream. These data have been integrated and generalized, as both lakes and streams show similar broad trends in this respect.

Drainage Density

In areas with long histories of fluvial erosion, or in areas with easily eroded, non-consolidated sediments, drainage density is a measure of relative surface runoff. Drainage density integrates precipitation, infiltration, and retention by vegetation. Most of the northern Yukon is non-glaciated; the remainder has unconsolidated Quaternary sediments which are easily eroded. Drainage density is therefore a meaningful descriptor of the land surface.

Drainage density measures the total length of stream channels per unit area. It can be measured laboriously by planimeter and distance-measurer. It can also be closely and rapidly approximated by counting the number of stream crossings, N, of a series of transects of total length L. Drainage density is then given by: $D = N/L \times 1.41$. We used the military grid lines on 1:250,000 maps as transects.

Drainage Types

Drainage types throughout the northern Yukon display one or more of a small group of associated features. These include channel pattern, bed load, the frequency of bars or islands, the degree of incision, the presence or absence of river terraces, the relative volumes of bank-full stage and low flow, the presence of icings, and the surrounding local relief. The drainage type classes follow.

Wetland drainage, as the name suggests, is common on organic soils. Wetland drainage typically consists of strings of small ponds; there is little surface water movement in summer. On sloping areas, such as upland bogs and in shallow depressions on pediments, wetland drainage ranges from small, ditch-like streams to seepage lines marked only by willow vegetation on an otherwise tussock tundra surface.

In mountain and hill environments, wetland streams and other non-confined runoff eventually merge to form gravel-bed streams. These are the typical occupants of most valleys, although they occur on pediments as well. They are commonly irregular to straight in plain view and often have one or two groups of poorly defined river terraces. These terraces are found within a few meters elevation of the present stream: their upper limits grade into the lower slopes of fans and pediments.

Gravel-bed streams are never deeply incised, and are always choked with gravel and boulder-size debris. Summer flow is very small; in several cases, water no longer flowed at the surface by late July 1977. Clearly these channels are highly active in the spring, when snowmelt produces enough discharge to move boulders. In view of the limited precipitation in the northern Yukon, the widespread occurrence of gravel-bed streams on uplands tells of a very quick thaw season and of very little aquifer or surface retention of water into the summer.

In the western half of the Northern Mountains Ecoregion, the gravel-bed headwater streams congregate to form braided channels. These are rivers with a sand and gravel bed load and many islands and bars. These islands and bars are usually willow-covered, flat-topped features also having coarse debris; they are both, in effect, in-stream extensions of floodplains.

In the eastern half of the Northern Mountains Ecoregion, meanders replace braided channels as the dominant river form. Meanders display finer sediments than braided channels. Beds are commonly small gravel and sand, whereas plains and terraces are usually sand and silt. As one moves eastwards, meandering streams become more entrenched. Near the Yukon/Northwest Territories border, there are some spectacular incised meanders, particularly on Rapid Creek. We have noted them for their remarkable visual appeal and geomorphological interest. In certain other areas, such as along the Old Crow River, an entire meander belt is incised below the surrounding landscape. This, too, we have described as an incised meander drainage type.

Gorges occur in only two situations. On Herschel Island, unconsolidated silt and clay are being rapidly denuded and deep gullies are the result. The valley-sides are subject to rotational slumping and mudflow. Consequently, the channels are very muddy and highly irregular due to blockage by slumped debris. The other gorges are along the Firth River, where the channel cuts deep into its own terraces and rejuvenated valley. For many tens of kilometers there is no room for floodplains, evidence that downward erosion is contemporary and continuing. Interestingly, the Firth feeds from headwaters well south of the height of land in the Northern Mountains. As a result, the continental drainage divide deviates southwards. This, plus the presence of gorges, indicates that the Firth is an antecedent

stream. It carves through rocks that have probably been above sea level for over one hundred million years. Since there has been no glacial disturbance here, the Firth may qualify as the oldest continuously active river in Canada.

The delta drainage type occurs only in the northeast corner of the study area. Here the Mackenzie Delta spills over into the Yukon Territory, forming a land of shallow lakes and tidal channels. No streams arise here; channels are limited to those passing through.

In any area it is important to know both the major and minor rivers and streams. They all affect trafficability, wildlife habitat, vegetation, soil drainage, etc. Large rivers are important for fisheries, recreation, water supply, and navigability. Equally, however, they often bear little ecological dependence on the areas through which they flow. Rather, they inherit many characteristics from upstream, such as regime and low flow, sediment load, and the energy to degrade or aggrade their beds. We felt, therefore, that native and exotic streams should be described separately. Native streams are those which rise within an ecodistrict; exotic streams come from outside.

In classing native streams, we identified the most common type of streams approaching the ecodistrict limits and finally leaving the area. This procedure demonstrates the most viable fluvial resources of each ecodistrict, even though they may not be the most extensive in occurrence. Also, throughout the northern Yukon, all drainage systems initiate as wetland or gravel-bed types, depending on the local terrain. To identify these as native types would have yielded only two classes, corresponding to uplands or to pediments and lowlands, for the entire survey area.

Icings

All aufeis (icings) are associated with braided streams. Aufeis results from groundwater discharge which, in winter, freezes into extensive sheets of ice. An icing can be several meters thick and cover the valley floor for up to 20 km of its length. Even though discharge continues in winter and summer flow is maintained by melting ice, these sites lack vegetation. Downstream from these sites, however, vegetation has been reported to be more varied and productive than elsewhere. Aufeis also generates thermal and discharge regimes favourable to Arctic Char. We have recorded it in our ecodistrict legend as the number of icing locations in or upstream of an ecodistrict and by a separate drainage type -- braided with aufeis.

MAP LEGEND CODE

While the codes for the ecodistrict map accompany the map itself, they are also presented here in Tables E2, E3, and E4.

Table E2: Code for elevation, relief, regional landform, genetic material, surface expression, modifying process, and depth and permafrost

Average Elevation (m a.s.l.)		Local Relief (m)		Regional Landform		Genetic Materials	
0	0 - 100	0	0 - 10	0	Angular Mountains	0	Bedrock
1	100 - 200	1	10 - 100	1	Rounded Mountains	1	Residual, Colluvial
2	200 - 300	2	100 - 200	2	Hills	2	Pediments, Bajada
3	300 - 400	3	200 - 300	3	Ridges	3	Fluvial
4	400 - 500	4	300 - 400	4	Hills & Broad Valleys	4	Organic
5	500 - 600	5	400 - 500	5	Ridges & Broad Valleys	5	Moraine
6	600 - 700	6	500 - 600	6	Rolling Plains	6	Lacustrine
7	700 - 800	7	600 - 700	7	Level Plains	7	Marine
8	800 - 900	8	700 - 800			8	Colluvial
9	900 -1200	9	800 +			9	N/A

Surface Expression		Modifying Process		Depth and Permafrost	
0	Steep	0	Cryoturbated	0	Veneer (<1m) with active layer of less than 30 cm.
1	Fan	1	Channelled	1	Blanket (>1m) with active layer of less than 30 cm.
2	Apron	2	Mass Wasting	2	Veneer with active layer of 30 to 60 cm.
3	Level	3	Frost Shattered	3	Blanket with active layer of 30 to 60 cm.
4	Horizontal	9	N/A	4	Veneer with active layer exceeding 60 cm.
5	Inclined			5	Blanket with active layer exceeding 60 cm.
6	Rolling			9	N/A
7	Terraced				
8	Slumps				
9	N/A				

Table E3: Code for texture, free water, reaction, soil subgroups, plant regions, and plant districts and associations

Texture	Free Water	Reaction Range
0 Blocky	0 Saturated for very prolonged periods	0 Acidic (pH's <5.5)
1 Rubbly	1 Saturated for short periods	1 Neutral (pH's 5.5 to 7.4)
2 Gravelly	2 Water free for moderately long periods	2 Alkaline (pH's >7.4)
3 Clay & Silt	3 Water free for prolonged periods	9 N/A
4 Diamicton	9 N/A	
6 Fibrous		
7 Mesic		
9 N/A		

Soil Subgroups	Plant Regions	Plant Districts and Associations
0 Orthic & Gleysolic Cryosols	0 Arctic Tundra	00 Unvegetated
1 Orthic & Regosolic Cryosols	1 Arctic Tundra - Alpine Tundra	01 Tussock - trailing heath tundra
2 Regosolic Cryosols	2 Alpine Tundra - Arctic Tundra	02 Alpine rock barrens
3 Regosolic & Orthic Cryosols	3 Alpine Tundra	03 Stream heathlands
4 Regosolic & Gleysolic Cryosols	4 Arctic Tundra - Taiga	04 Sedge-moss fenlands
5 Orthic & Brunisolic Cryosols	5 Taiga	05 Tussock and trailing heathland tundra
7 Fibric & Mesic Cryosols		06 Riparian woods
8 Mesic & Fibric Cryosols		07 Tussock - dwarf heath tundra
9 N/A		08 Tussock - low shrub tundra
		09 Open spruce-lichen
		10 Herb-heathlands
		11 Alpine tundra - open spruce
		12 Arctic tundra - open spruce
		13 Dryas-heath alpine
		14 N/A

Table E4: Code for lake cover, lake size, drainage density, drainage type, icings, and pH

Code	Lake Cover (%)	Code	Lake Size (hectares)	Code	Drainage Density (No. streams/km)
0	0	0	0 - 1	0	0 - .2
1	0 - 1	1	1 - 3	1	.2 - .3
2	1 - 5	2	3 - 5	2	.3 - .4
3	5 - 10	3	5 - 10	3	.4 - .43
4	10 - 20	4	10 - 25	4	.43 - .46
5	20 - 30	5	25 - 50	5	.46 - .5
6	30 - 40	6	50 - 100	6	.5 - .6
7	40 +	7	100 - 250	7	.6 - .7
				8	.7 - .8

Code	Drainage Type Native Exotic
0	Wetland
1	Gravel-bed
2	Meander
3	Incised Meander
4	Gorge
5	Braided
6	Braided Aufeis
7	Deltaic
9	N/A or None

Icings

No. in District and on inflowing stream

Code	Lake and River pH's generalized
1	<6.5
2	6.5 - 7.0
3	7.0 - 7.5
4	>7.5

SECTION F

OUTSTANDING PHENOMENA

INTRODUCTION

In any attempt to outline the outstanding phenomena of the northern Yukon, clichés and superlatives are very difficult to circumvent, as the area has numerous features which make it of special significance. This is evidenced by a vast range of interest groups, including the Canadian Wildlife Service, Parks Canada, the International Biological Program (Nettleship and Smith, 1975; Beckel, 1975), the World Heritage Convention of UNESCO (Bennet, 1977), the Canadian Arctic Resources Committee (CARC), the Inuit Tapirisat, the Arctic International Wildlife Range Society (Calef, 1974), the Mackenzie Valley Pipeline Inquiry, the Alaska Highway Pipeline Panel, and the Committee for Original Peoples' Entitlement (COPE).

The area has many marks of distinction -- the spectacular beauty of the mountain ranges and the Firth River valley; numerous unique and often spectacular landforms; innumerable wildlife, which can suddenly appear in breathtaking numbers; diverse flora; archaeological and paleontological sites unequalled elsewhere in Canada; and a recent history which helped to shape the pattern of development of northern Canada. Even the climate of the northern Yukon is unique in that it is the mildest area of Arctic Canada, giving rise to the nickname 'banana-belt of the Arctic'.

Before continuing, an explanation of 'outstanding' is warranted. Terminology varies according to personal interests; synonyms could include 'unique', 'classical', 'significant', 'rare', 'exceptional', 'striking', 'uncommon', or simply 'odd'. Rather than choosing any one sense, 'outstanding' is used in a broad context to cover phenomena which have intrinsic ecological value, and the distinction of being outstanding must be considered from the perspective taken (ie regional, national, or international). Although many outstanding phenomena of the northern Yukon are discussed, this report is not fully comprehensive. Phenomena were identified through exploratory overflights of the area, through personal communication with previous investigators of the area, and from the literature.

In the sections which follow, many outstanding phenomena of the study area will be discussed. Where possible, phenomena will be related to ecological land units (ecoregions or ecodistricts), and the descriptions will follow a general north-to-south trend.

OUTSTANDING PHYSICAL FEATURES

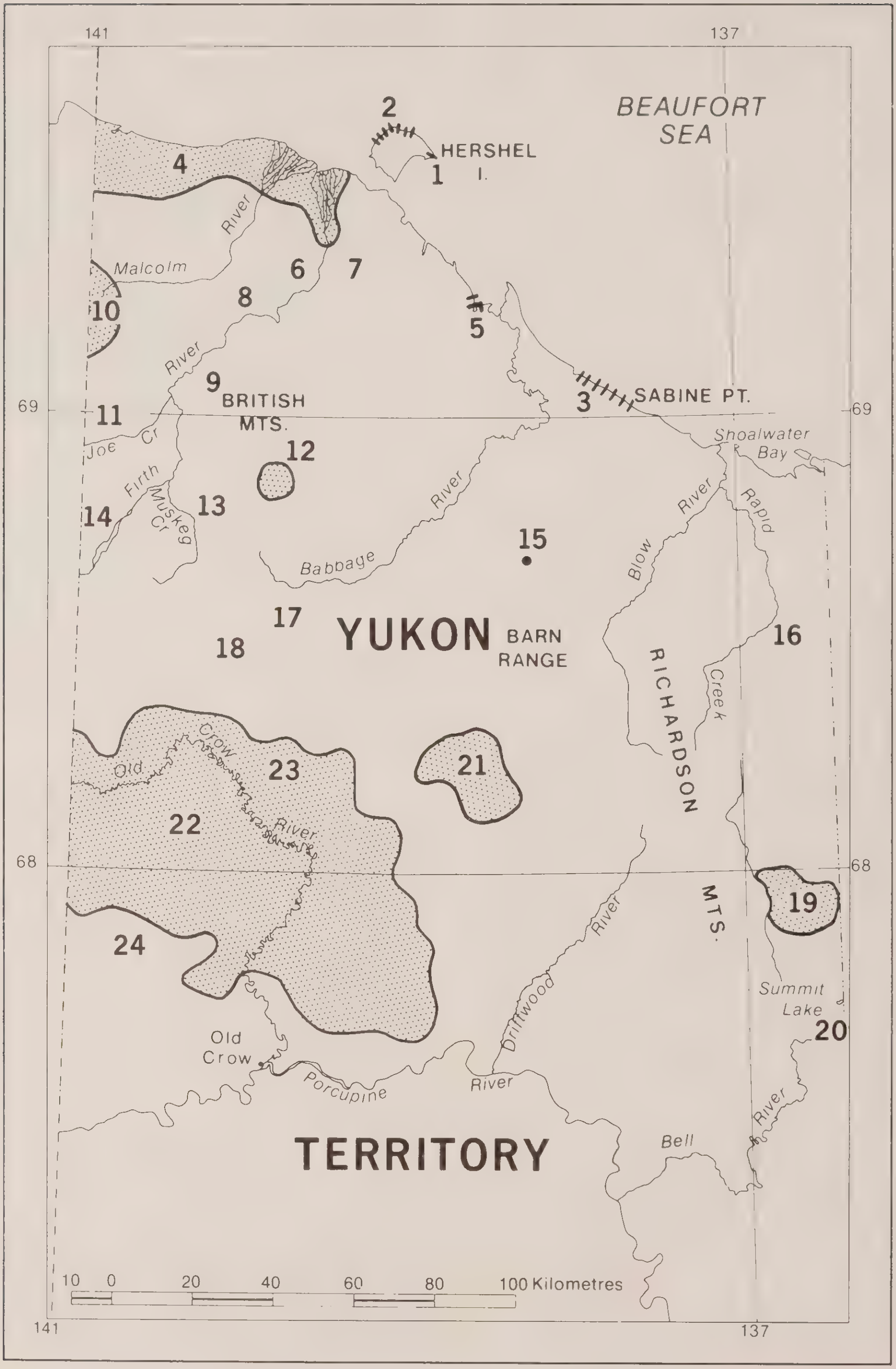
The northern Yukon contains the only extensive area in continental Canada which escaped Quaternary glaciation. For various reasons, there were not even any local ice caps or cirque glaciers. Consequently, the study area exhibits physical features not found in other parts of Canada; ice sheets did not destroy the physical features which developed over millions of years of denudation. This lack of glaciation and the semi-arid arctic climate have combined to produce features which are unusual in Canada. These include inselbergs (prominent isolated, steep-sided residual hills), cryopediments (gently inclined erosional surfaces developed at the foot of valley sides), and cryoplanation terraces (formed by erosional processes associated with frost action). Periglacial activity has also produced many tors, crags, and residual pinnacles on upper mountain slopes.

It would be difficult to find elsewhere in Canada an area which includes such a variety of rock types (limestone, shale, sandstone, chert, quartzite, slate, conglomerate, granite, mudstone, and basalt) and mountain types which include a wide range of structural, tectonic, and constructional forms. The widespread sedimentary limestone and shale formations of the British and Richardson mountains display various degrees of folding and faulting and also include intrusions of volcanic formations. In contrast, the Barn Range contains many buttes and mesas.

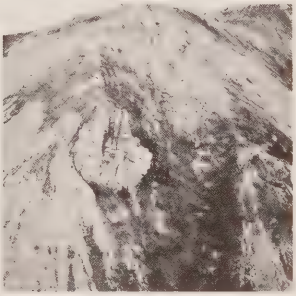
The study area is marked by strong physiographic contrasts over short distances, such as between the Old Crow Flats, the British Mountains, the Barn Range, and the Northern Coastal Plain. These differences are emphasized by the density and patterns of lakes, or their absence, which cover large areas of the landscape. In addition, the general lack of trees in the Northern Mountains and the Northern Coastal Plain ecoregions provides the viewer with many other clear, 'textbook' examples of a variety of fluvial, periglacial, colluvial, bedrock, and littoral features.

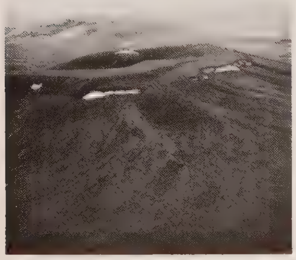
Where glaciers did encroach into the northern Yukon, as along the eastern Northern Coastal Plain Ecoregion, their limit was controlled largely by physiography. The result is that the Quaternary margin falls neatly along a major physiographic boundary, and that boundary is itself marked in places by ice margin features such as truncated spurs and glacial meltwater channels. Further west, this ecoregion was not glaciated; as a result, there are marked differences in physiography and

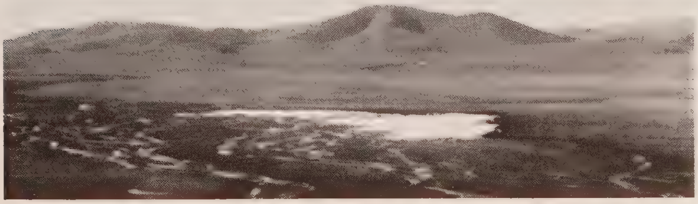
Figure F1: General locations of some outstanding phenomena



1. HISTORICAL IMPORTANCE
2. SPECTACULAR SLUMPS AND FLOWS; MASSIVE ICE BEDS
3. SPECTACULAR SLUMPS; MASSIVE ICE WEDGES AND ICE BEDS
4. KOMAKUK PLAINS PANORAMA
5. STRAND LINES
6. ENGIGSTCIAK
7. SPILLWAY LAKES
8. SPECTACULAR LOWER FIRTH RIVER GORGES; NORTHERNMOST WHITE SPRUCE IN CANADA
9. SPECTACULAR GORGES OF CENTRAL FIRTH RIVER
10. VOLCANIC ROCKS
11. JOE CREEK AUFEIS
12. VIEWPOINT RIDGE
13. STAND OF IMMENSE BALSAM POPLAR TREES
14. AUFEIS OF FIRTH RIVER HEADWATERS
15. SLEEPY MOUNTAIN - INSELBERG
16. INCISED MEANDERS OF RAPID CREEK
17. HORSESHOE HILL
18. BEADED DRAINAGE OF TIMBER CREEK TRIBUTARIES
19. WHITE MOUNTAINS
20. SUMMIT LAKE
21. PEDIMENTS AND FEATHER DRAINAGE
22. OLD CROW FLATS - ORIENTED LAKES; WATERFOWL AND MUSKRAT HABITAT;
23. OLD CROW RIVER - ARCHAEOLOGICAL SIGNIFICANCE; PRONOUNCED INCISED MEANDERS; OXBOWS, OXBOW LAKES AND MULTIPLE OXBOW LAKES
24. TORS OF OLD CROW RANGE







biota between the two portions of the ecoregion. Superimposed on the whole study area is a Tertiary and Quaternary history of tectonic and eustatic land/sea level changes. Most of the major rivers are consequently entrenched, albeit in different ways -- the Firth is in a gorge with rock terraces above, the Babbage is an entrenched braided river, while Rapid Creek has a series of pronounced incised meanders.

The dry arctic climate is responsible for great seasonal variations in discharge in all rivers of the area. Many streams display only a trickle of water in summer and yet possess boulder-strewn beds, indicative of high spring flows. Except at some locations on the Northern Coastal Plain, river waters are free of suspended sediment. Massive icings or aufeis are prevalent in the study area, particularly in the headwaters and lowermost reaches of the Firth and Malcolm rivers.

In low-lying areas, particularly in the Old Crow Flats and King Plains ecodistricts, frost polygons are common; ice wedges are occasionally displayed in river cuts and along the Arctic coast. Patterned-ground wetland areas often display a distinctive beaded form of drainage.

The shorelines along the Beaufort Sea, including those of Herschel Island, are typified by cliffs of non-consolidated marine sediments. In both cases they are subject to rapid erosion by waves, thermal niching, and slumping. These sediments contain little sand or gravel; thus, such narrow beaches as do exist provide minimal protection against erosion and must be considered very precarious resources.

Lakes are especially common in the King Plains and Old Crow Flats ecodistricts. In the latter area, many lakes are squarish or rectangular and oriented in a northwest/southeast direction. Surprisingly, however, all lakes are very shallow, being less than two meters deep.

SPECIFIC OUTSTANDING PHYSICAL FEATURES

The general locations of the features outlined below are shown on Figure F1; they are arranged here according to the ecoregions within which they are found.

a) Northern Coastal Plain Ecoregion

Well-developed strandlines occur in the southwest portion of Phillips Bay. This succession of elevated shorelines bordering the Beaufort Sea documents the almost-continuous post-glacial rise of the land surface following the removal of the ice load.

Numerous glacially deformed sections of Pleistocene sediments are exposed along a stretch of coastline for about 500 km between Herschel Island and Nicholson Peninsula in the N.W.T. (Mackay, 1956, 1959, 1963a, and 1971). The north and northwest coasts of Herschel Island and a roughly 13 km stretch of the coastal mainland around Sabine Point exhibit a particularly high concentration of spectacular slumps and flows (Plates F1 and F2). Marine activity results in almost continuous exposure of ice-rich marine and moraine sediments. As the ice melts, the sediments slump, creating cliffs 10-15 m high. Sediments in these areas commonly contain excess ice to 10-13 m, and excess ice has been noted as deep as 26 m (Rampton, 1971). In the Sabine Point area, massive ice wedges and ice beds are evident (Plate F3); on Herschel Island, however, only massive ice beds are exposed.

Plate F1: Slumps and flows along the north coast

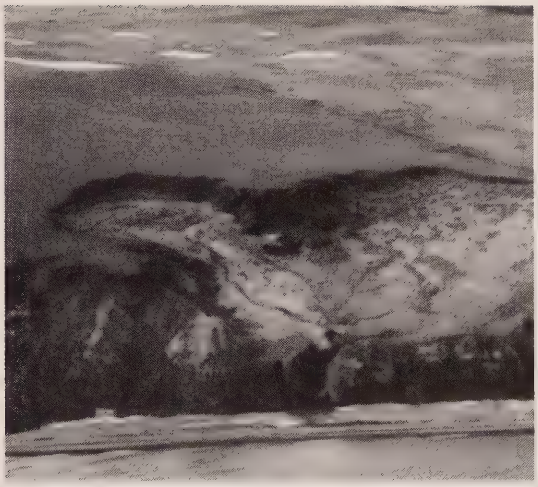


Plate F2: Slumps and flows near Kay Point

Plate F3: Massive ice wedges and ice beds in the area of Sabine Point

Some of the coastline in the Komakuk Plains Ecodistrict exhibits unique arctic beach features. During freezeup, pieces of sea ice, sludge ice, frazil, frozen swash mass, and snow may be incorporated in or over the beach structure (Short and Wiseman, 1975). During spring thaw, snowmelt flows over the frozen beach surface, and ice and snow embedded in the beach sediments melt, creating two types of features: irregular, stream-dissected surfaces, with distorted upper beach layers (up to 1.5 m thick) containing mottled and complex interbedding; and irregular, melt-dissected beach faces (ie patterns due largely to the melting of the embedded ice and snow).

The Komakuk Plains Ecodistrict, especially in the lowermost reaches of the Malcolm and Firth rivers, is an almost unbroken plain. Relief features are almost non-existent, and with the absence of trees, the plain offers a striking panorama (Plate F4).

Plate F4: Extensive level plain in the Firth River Delta

b) Northern Mountains Ecoregion

A line of spillway lakes exists in the Buckland Basin and Babbage Plains ecodistricts near the Firth River. These lakes are relicts of a glacial meltwater channel which marked the border of the northwesternmost limit of Quaternary glaciation in Canada. The spillway lakes east of the Firth River in the Babbage Plains Ecodistrict are especially noteworthy because of the surrounding high cliffs (Plates F5 and F6).

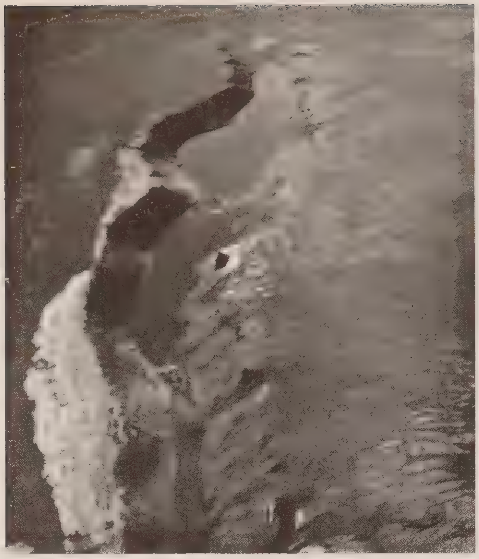


Plate F5: Spillway lakes east of the Firth River

The position of these lakes coincides closely with other features which demarcate the limit of glaciation, such as the truncated spurs of the foothills of the north slope.

Engigstciak, a major archaeological and paleontological site (which will be discussed later in more detail), is a prominent geological outcrop in the northeastern portion of the Buckland Basin Ecodistrict near the east bank of the Firth River (Plate F7).

Plate F7: Engigstciak -- A site of many important archaeological and paleontological discoveries

Plate F6: Spillway lakes east of the Firth River

Through the British Mountains, the Firth River incises its way through spectacular gorges (Plate F8). The translucent water, tinted greenish-blue by dissolved calcium carbonate, continuously alters its behaviour along its route to the Arctic Ocean. The river rushes in torrents through narrow canyons, cascades down chains of rapids, accumulates in deep, eddying pools, or moves lazily along broad, shallow channels. The bedrock terraces of this portion of the Firth River are also prominent.

Abruptly, at the border between the Malcolm River and Buckland Basin ecodistricts, the Firth River leaves its single entrenched channel and braids into a number of smaller, shallower channels over a broad river bed. Enhancing the dramatic conversion is the simultaneous disappearance of the rugged British Mountains which give way to the panorama of the lower, rounded Buckland Hills and the smooth, flat coastal plain.

Plate F8: The deeply incised Firth River

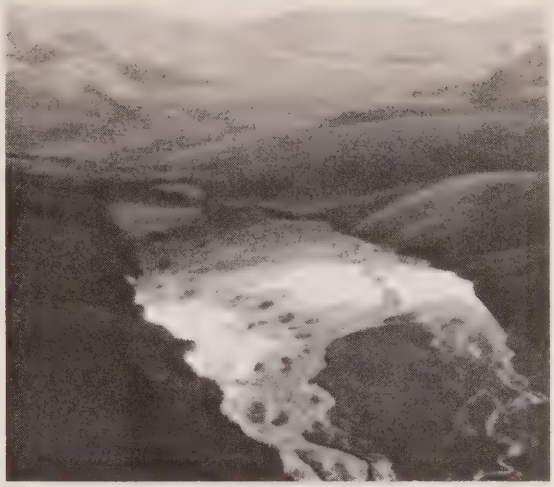


Plate F9: Aufeis in the headwaters of Joe Creek

The aufeis or icings in the headwaters of the Firth River and Joe Creek (Plate F9) are quite spectacular and are prominent even on LANDSAT images. The Firth River aufeis is particularly impressive, covering about 20 km^2.

A mountain ridge in the Upper Trail River Ecodistrict provides a striking southern prospect. At an elevation of roughly 1,100 m, 'Viewpoint Ridge' overlooks the broad valley of the headwaters of the Trail River. The extensive, green plain is abruptly terminated by and contrasts pleasantly with the enclosure of rounded gray limestone formations of the British Mountains (Plate F10). The upper portion of this ridge, which is exemplary of cryoplanation, consists of a series of frost-fractured, shale terraces.

In the northeastern portion of the Timber Creek Ecodistrict, at an elevation of roughly 700 m, is a prominent horseshoe-shaped outcrop (Plate F11). Surrounded by an expansive rolling, tundra-covered plain, 'Horseshoe Hill' is a protrusive landmark.

Thermokarst drainage patterns are widespread in lowland areas of the northern Yukon, particularly where fine-textured superficial materials contain a very high proportion of excess ice. Overland flow of water may cause thermal erosion of some of this excess ice, and the collapse of surface materials through the displacement of water results in small round ponds which are linked by shallow, narrow

Plate F10: View south over the valley of the headwaters of the Trail River. Barren ground caribou in foreground on a cryoplanation terrace.

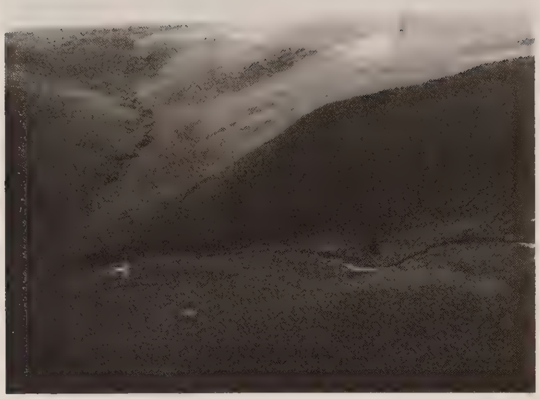


Plate F11: Horseshoe-shaped outcrop in the Timber Creek Ecodistrict.

channels. A striking example of this drainage pattern exists in the southeast portion of the Timber Creek Ecodistrict, where tributaries of Timber Creek display distinct beaded patterns (Plate F12) which extend uninterrupted for over 20 km.

Plate F12: Beaded drainage patterns of the tributaries of Timber Creek.

Sleepy Mountain (Plate F13), an inselberg in the eastern portion of the Blackfold Hills Ecodistrict, at an elevation of roughly 1,000 m, is a conspicuous landmark. This and other inselbergs warrant recognition as national landmarks.

The White Mountains (Plate F14) are another major landmark of the northern Yukon. The sharp contrast between the whiteness of these limestone peaks and the darkness of the surrounding rocks of the Richardson Mountains, and the sharply defined boundary between the rock types, makes them a particularly conspicuous feature in the study area. These mountains are also prominent on aerial photographs and LANDSAT images.

Rapid Creek, in the vicinity of Mount Davies Gilbert in the northern portion of the Richardson Folds Ecodistrict, is exemplary of incised meanders (Plate F15). As the river meanders laterally, it also deeply incises the surface materials.

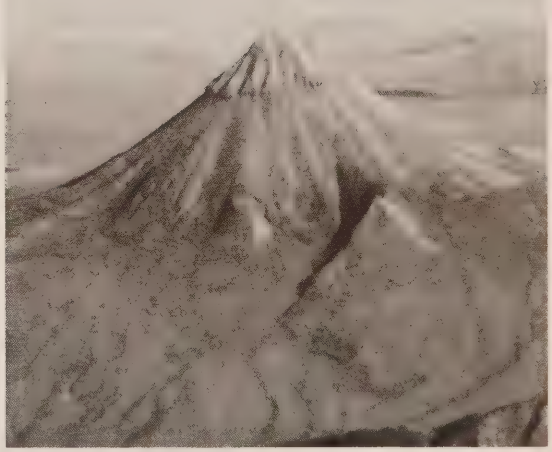


Plate F13: Sleepy Mountain, an inselberg in the Blackfold Hills Ecodistrict.

Summit Lake, in the southeast corner of the Bell River Ecodistrict, is unique in that it is

Plate F14: The White Mountains within the encircling darker Richardson Mountains

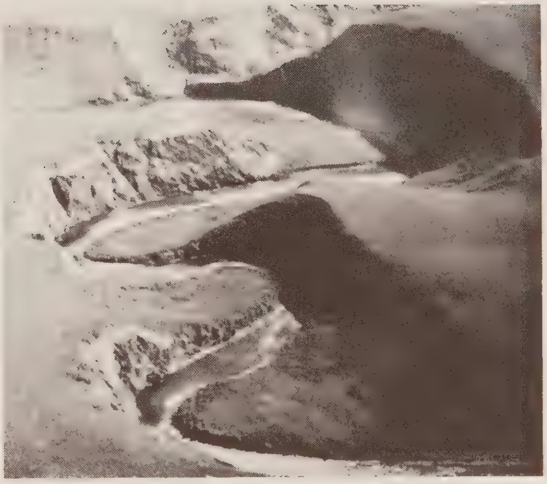


Plate F15: Incised meanders of Rapid Creek in the Richardson Folds Ecodistrict

situated upon a continental divide. Located in a major pass in the Richardson Mountains (Rat Pass or McDougall Pass), water from the lake and environs drains southwesterly to the Bell River, and some water also seeps easterly to the Rat River.

c) Old Crow Basin Ecoregion

The Old Crow Flats Ecodistrict, which covers roughly 5,000 km^2, is a spectacular wetland which includes hundreds of lakes of various kinds. Many of the larger lakes are square or rectangular (Plate F16) and oriented in a northwest-southeast direction. A number of theories have been proposed regarding the origin of these oriented lakes. Price (1968) describes them as being due to subsidence over fault or fissure blocks. He feels that the 'fault-block origin' is supported by the large, square drainage patterns with which the lakes are associated and in the squares in which most of the lakes lie. Many other lakes of the ecodistrict are clearly the remains of larger in-filled oriented lakes. Still other lakes of the Old Crow Flats Ecodistrict are of fluvial origin. Whereas all rivers and streams of the ecodistrict meander, the meanders of the Old Crow River are notably pronounced along its full length. This has led to the formation of innumerable oxbows (Plate F17) and oxbow lakes (cut-off lakes), and in some cases even multiple oxbow lakes where these lakes are in

Plate F16: Angular and oriented lakes of the Old Crow Flats Ecodistrict

contact. In some cases, rather long stretches of meandering channel have been cut off from the main stream, leaving snake-like serpentine lakes. A fourth type of lake, which appears to be of the thermokarst variety, is also widespread and numerous in the ecodistrict. Lakes of this type are small, roundish, and form dense patterns. They may have been formed by the melting of blocks of ice which formed in permafrost prior to Quaternary glaciation. Regardless of the origin of lakes in the Old Crow Ecodistrict, all lakes are very shallow (less than 2 m deep) and have bottoms of organic debris.

Plate F17: Oxbow of the Old Crow River

Pediments are a recognized feature of unglaciated arid and semi-arid areas. They are conventionally associated with hot, desert climates of the mid-latitudes, rather than with dry, polar environments. Since the majority of Canada has been glaciated, and as very little can be considered arid or semi-arid, pediments are restricted and uncommon in this country. Nonetheless, pediments are widespread in the unglaciated intermountain areas of the northern Yukon, and vast, uninterrupted pediment plains exist in the Old Crow Pediments Ecodistrict. A particularly impressive pediment is located in the northeast portion of the ecodistrict between Black Fox and Johnson creeks (Plate F18). The pediment is further enhanced by the feather-like drainage pattern which etches the surface. The sharp contrast between the willows and aquatic sedges of the drainageways and the predominately tussock tundra matrix of this portion of the ecodistrict is prominent on aerial photographs and from the air.

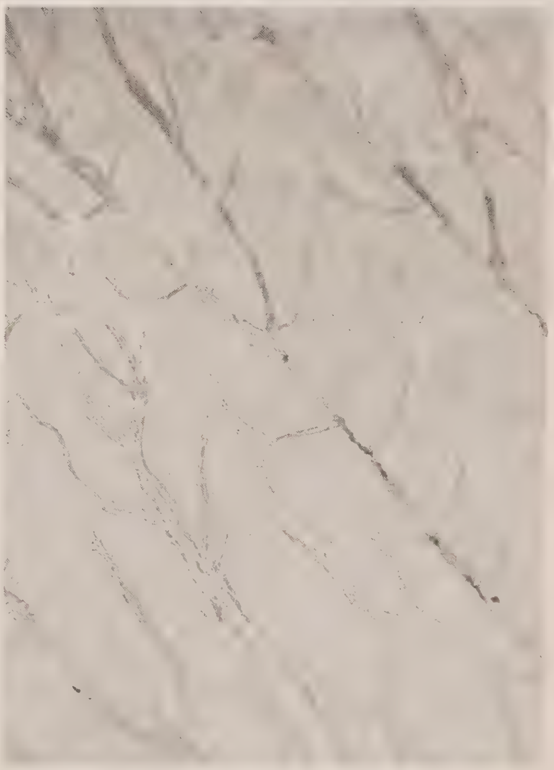


Plate F18: Old Crow Pediments with feather-like drainage patterns.

d) North Ogilvie Mountains Ecoregion

As only 632 km^2 of this ecoregion (with its sole ecodistrict, the Old Crow Range Ecodistrict) fall within the study area, outstanding features are understandably limited as far as this report is concerned. Nevertheless, the ecoregion possesses numerous tors (Plate F19), bedrock structures characteristic of unglaciated areas. They consist of angular, frost-shattered rock protuberances surmounted by blocks and boulders. Tors usually develop in highly fissible sandstones, shales, and dolomites -- rocks which are especially susceptible to frost wedging but which are sufficiently resistant to form 'rock stack' structures (French, 1976). In the North Ogilvie Mountains Ecoregion, the tors are typically of the summit variety, being surrounded by slopes of low angle (<5-7°); in the British Mountains of the Northern Mountains Ecoregion, however, the tors are of the side-slope type (Plate F20), and are surrounded by slopes commonly between 20° and 30° in angle, depending on lithology. Sideslope tors

Plate F19: Summit variety tors of the Old Crow Range Ecodistrict

Plate F20: Sideslope tors of the Northern Mountains Ecoregion

generally develop through slope retreat and frost wedging. They occur on the middle or upper parts of slopes and are surrounded by coarse, angular debris which move downslope under gravity leaving the more resistant protruding structures (French, 1976).

OUTSTANDING BIOLOGICAL FEATURES

A) WILDLIFE

Although the northern Yukon has few resident wildlife species, the rapid lengthening of the daylight hours towards the seemingly endless summer 'day' heralds the spring migrations which bring numerous members of scores of species. In the warmth of the short-lived summer, the northern Yukon is perhaps the most productive area for wildlife in the Canadian Arctic.

a) Mammals

The most prominent of the northern Yukon's wildlife are the barren ground caribou of the Porcupine herd, one of the world's largest remaining herds, and estimated in 1977 at about 105,000 animals (Alaska Highway Pipeline Panel, 1978). In the course of their annual migration, the herd ranges throughout the northern Yukon and into northeastern Alaska and the northwestern District of Mackenzie of the Northwest Territories, traversing all kinds of terrain within an area of about 250,000 km^2. The herd's behavioural patterns were shaped thousands of years ago and this massive collection of animals continues to use summer and winter ranges similar to what it used in the past. A study of the location of ancient Kutchin caribou corrals suggests that caribou movement patterns then were much as they are today (Alaska Highway Pipeline Panel, 1978). This herd is recognized by many as the most important renewable resource of the northern Yukon -- as well as being an outstanding natural phenomenon because of its immenseness and age-old behavioural patterns, for as far back as there is record the herd has provided food for the people of the area, and it continues to be important for the long-term well-being of the northern Yukon's native people. The herd is also used by native people in Alaska. The international significance of the herd is reflected in the Alaskan Arctic Wildlife Range, a nine million acre (3.64 million hectare) tract of land in northeastern Alaska, established primarily to protect the herd.

Other important ungulates inhabit the northern Yukon. The area boasts the northernmost populations of Dall sheep in Canada, including a population of roughly 500 animals in the Richardson Mountains along the west bank of the Firth River. Moose are common along river valleys, particularly in the Old Crow Flats Ecodistrict, and they may be found as far north

Plate F21: Caribou of the Porcupine herd on cryoplanation terrace in the Northern Mountains Ecoregion

Plate F22: Whistling swans in sedge meadow along the coast in the Northern Coastal Plain Ecoregion

Plate F23: Golden eagle eyrie on tor in the Northern Mountains Ecoregion

as the Northern Coastal Plain. Muskoxen, long absent from the area, were introduced to the northeast corner of Alaska in 1969 and 1970, and some have dispersed south and east into the British Mountains. Although rare, sitings of muskoxen in the northern Yukon are occasionally reported.

The northern Yukon has a population of at least 700 barren-ground grizzly bears; this represents one of the largest concentrations of grizzlies remaining in North America (Calef, 1974). In the Barn Range, population densities have been estimated at one bear per 37 km^2 (Pearson, 1977). The northern Yukon is quite exceptional and perhaps unique for bears since all three species of North American bears (grizzly, black, and polar) roam the area. At least 5,000 beluga (white) whales summer in the waters of the Shoalwater Bay Ecodistrict and the surrounding Beaufort Sea (Sergeant and Brodie, 1975); this is one of the largest populations in North America.

Furbearers are also well-represented in the northern Yukon, particularly in the Old Crow Flats. The numerous lakes with aquatic vegetation of the Flats are prime muskrat habitat. A few beaver and mink also live in the Flats. Arctic Fox are common on the north slope, and the King Plains and Herschel Island ecodistricts provide prime denning habitats for arctic fox and a number of red fox. Upwards of 400 wolves hunt throughout the area. Lynx and marten occupy the treed areas of the taiga ecotone, whereas wolverines range throughout the northern Yukon.

b) Birds

The Old Crow Flats Ecodistrict provides the most important waterfowl habitat in the Yukon Territory. The Flats provide breeding, moulting, and staging habitat for hundreds of thousands of waterfowl, including canvasback, scaup, scoter, widgeon, oldsquaw, mallard, teal, whistling swan, and the rare tule sub-species of the white-fronted goose (Calef, 1974). About 80,000 ducks breed in the Flats (Smith, Dufresne, and Hansen, 1964), and up to a half million ducks may stage there in the late summer, preparatory to fall migration. The Flats are even more important during drought years on the prairies. In 1960, for example, a drought year on the prairies, breeding ducks numbered more than 170,000 (Smith, Dufresne, and Hansen, 1964).

The Northern Coastal Plain probably ranks a close second behind the Old Crow Flats as an important waterfowl habitat in the Yukon. The ubiquitous shallow, highly productive lakes and ponds of the King Plains Ecodistrict and the innumerable lakes, ponds, lagoons, and river channels of the Shoalwater Bay Ecodistrict provide essential breeding, moulting, staging, and migrating habitat for countless birds. Fully one-fifth of the world's population of whistling swans, the largest birds of the northern Yukon, nest along the Yukon Coast and in the lower Mackenzie Delta (Barrie, 1971). These birds need large territories and find conditions on the Northern Coastal Plain ideal, for most breeding pairs are able to have a small lake for themselves. Arctic tern, arctic loon, pintail, oldsquaw, and merganser also nest in great numbers along the Northern Coastal Plain. In late August and September, up to half a million lesser snow geese stage on the plain, grazing and feeding on berries to gain weight before their long southward migrations.

The lagoons, beaches, spits, and islands along the coast are also prime bird habitats. Shallow lagoons such as Clarence Lagoon and those at Phillips Bay, Stokes Point, and King Point are used for breeding, moulting, and staging by many waterfowl species, and the river deltas are heavily used by migrating ducks, geese, swans, loons, terns, gulls, and many species of shorebirds. The total number of birds migrating along the Northern Coastal Plain is in the millions.

The whole of the northern Yukon, and particularly the Northern Mountains Ecoregion, provides essential habitat for raptors such as peregrine falcon, gyrfalcon, golden eagle, snowy owl, and rough-legged hawk. The peregrine falcon is most notable as it has disappeared entirely from most of its former range, and this species is among the rare and threatened birds of Canada listed by Goodwin (1977). The Old Crow Flats Ecodistrict is the breeding and fishing habitat for the northernmost population of osprey in Canada (Calef, 1974).

As most birds which breed, moult, and stage in northern Yukon spend part of the year outside of Canada (some such as the artic tern and semi-palmated plover winter as far away as South America and the Antarctic), the area provides pivotal habitats for important international wildlife populations.

c) Fish

The study area contains many important fish habitats. Arctic cisco are abundant in the brackish water areas of the Beaufort Sea and the lower reaches of large muddy rivers (McPhail and Lindsey, 1970). This species is unique in that it is the only species whose North American range is confined to the western

Beaufort Sea coast -- it probably survived the Wisconsin glaciation along the unglaciated Beaufort Sea coast and has scarcely expanded its North American range since that time. Roughly 115,000 chum salmon and smaller numbers of chinook and coho salmon annually migrate over 2,000 km from the Bering Sea to spawn in the westerly draining Porcupine River. The chum run reaches a peak in early September, whereas the chinook run peaks in mid-July and the coho in mid-August (McPhail and Lindsey, 1970). In fall, the Firth and other major north-flowing rivers team with anadromous Arctic char swimming inland to spawn and overwinter. All the northern Yukon's Arctic char overwinter in a few spring-fed pools of these rivers (McCart, 1974). The rivers and streams of the study areas are also important for many other fish, including Arctic grayling, inconnu, three species of whitefish (round, broad, and humpback), least cisco, and northern pike.

B) VEGETATION

The northern Yukon is one of the few areas in Canada where three vegetation regions meet. In most other such areas, disturbance by man has been so great that pioneer or weedy species abound and the uniqueness of the area is undermined. In the study area, however, arctic tundra, alpine tundra, and taiga can all be observed in their natural condition.

The taiga (open, largely coniferous forest) is represented by white spruce (Picea glauca), white or paper birch (Betula papyrifera), balsam poplar (Populus balsamifera), green or mountain alder (Alnus crispa), prickly rose (Rosa acicularis), and high concentrations of ground lichens, particularly cushions of reindeer lichens (Cladina rangiferina, C. mitis, and C. alpestris). In this area, 300 km north of the Arctic Circle, white spruce of considerable size are locally abundant (especially on south-facing slopes) and the spruce stretch almost to the Arctic Ocean along the Firth River -- the most northerly extension of coniferous trees in Canada. The Joe Creek and Riggs Mountain ecodistricts also include mature stands of large balsam poplars (up to 11 m in height and 23 cm dbh) with accompanying lush understories of glaucous larkspur (Delphinium glaucum), monkshood (Aconitum delphinifolium), valerian (Valeriana capitata), tall lungwort (Mertensia paniculata), Siberian aster (Aster sibiricus), etc.

Typical arctic tundra species include sheathed cottongrass (Eriophorum vaginatum), aquatic sedge (Carex aquatilis), netted willow (Salix reticulata), arctic willow (Salix arctica), white arctic bell-heather (Cassiope tetragona), arctic dock (Rumex arcticus), and arctic avens (Dryas integrifolia).

Typical of alpine tundra are mountain avens (Dryas octopetala), alpine bearberry (Arctostaphylos alpina), tufted alpine saxifrage (Saxifraga caespitosa), three-toothed saxifrage (Saxifraga tricuspidata), and crustose lichens.

The melding of these three vegetation regions results in a high diversity with over 300 species of native vascular plants and roughly 100 species of bryophytes and lichens.

The study area has a fairly high proportion of endemic plant populations. A population of plants is said to be endemic if it occurs naturally in a restricted area and if, at the same time, it is unique in some respect (Mosquin, 1971). Most endemics in Canada were formerly quite widely distributed, but their distribution range was reduced by glaciation and other natural forces. They are of the type which Stebbins (1942) calls 'genetically depleted' -- they are genetically homogeneous (ie they have few biotypes and are relatively homozygous) and therefore do not have the hereditary resources in terms of heterozygosity to be able to invade many kinds of environments and therefore to spread. They exist only in limited areas today mainly because they failed to spread after having survived the Wisconsin glaciation on ice-free refugia or nunataks, as in the mountainous areas of the study area. 'Insular' endemics were never widespread in Canada. They are rare in Canada because glaciation generally destroyed them, except for occurrences in unglaciated areas such as in the northern Yukon. The higher elevations of the unglaciated mountains of this area provide several examples of insular endemics.

Some possible endemics of the northern Yukon and environs in North America include Salix niphoclada var Mexiae, S. hastata, Polygonum alaskanum, Cerastium maximum, Minuartia macrocarpa, Dianthus repens, Papaver Macounii, P. McConnellii, Boykinia Richardsonii, Saxifraga punctata ssp Nelsoniana, S. exilis, S. davurica ssp grandipetala, S. reflexa, Spiraea Beauverdiana, Dryas octopetala ssp octopetala, Lupinus arcticus, Douglasia ochotensis, and Dodecatheon frigidum.

Plate F24: Stand of large balsam poplar trees along Muskeg Creek in the Northern Mountains Ecoregion

Plate F25: Some of the northernmost white spruce in Canada, along the Firth River in the Northern Mountains Ecoregion

Plate F26: Lush vegetation in sheltered valley in the Northern Coastal Plain Ecoregion; feltleaf willow commonly exceeds 3 meters in height

Plate F27: Taiga; open stand of white spruce with understory of continuous cover of heath species, moss, and lichen

Plate F28: Arctic tundra; continuous cover of cottongrass, heath species, moss, and lichen

Plate F29: Alpine tundra; barren to sparse cover of mountain avens, alpine bearberry, and species of saxifrage

PALEONTOLOGICAL AND ARCHAEOLOGICAL SIGNIFICANCE

The lack of glaciation in the northern Yukon renders the area invaluable for archaeology and paleontology. Several areas have yielded important artifacts and fossils providing information concerning human life since late Wisconsin as well as evidence of climates, flora, fauna, and physical features dating back to 40,000 years or more. Such information is of inestimable value. It assists in the understanding of the factors determining the present status of and past trends in habitation, climatology, biology, and geomorphology.

The major archaeological areas are associated with specific locations such as Engigstciak and Klo-kut, as well as with various parts of the Old Crow Basin. While these areas are primarily noted for the remains of human life and activities, they are also important for paleozoological studies.

Every major known Inuit culture camped and left traces at Engigstciak, a site on the east bank of the Firth River about 20 km from the Arctic Ocean and 25 km SW of Herschel Island (Bennet, 1977). Probably because of the deep entrenchment of the Firth River channel and the ruggedness of the British Mountains, caribou migrate more frequently along the Northern Coastal Plain and environs than they do farther south. Thus, because of the strategic position of Engigstciak (this point of land 174 m above sea level provides an unobstructed view of the lower Firth River canyon and the Northern Coastal Plain), it was occupied by numerous groups at many times -- excavations have revealed artifacts indicating nine different archaeological complexes (MacNeish, 1956a). The Engigstciak site is also rich in bones of ungulates no longer found in the northern Yukon (wapiti, bison, and horse) and of animals still found there.

Another particularly significant archaeological area exists in the Old Crow Flats. Virtually the whole length of the Old Crow River yields fossils and artifacts and one site has provided evidence, in the form of a caribou bone tool which was possibly a fleshing implement, that man may have occupied the area as long ago as 27,000 years B.P. -- by far the oldest record for Canada (Irving and Harington, 1973).

Other archaeological surveys and excavations in the middle Porcupine drainage provide a glimpse of the later prehistory of the region, notably the Klo-kut site. Klo-kut is a large stratified site located on the north bank of the Porcupine River, about 10 km upstream of the village of Old Crow (Morlan, 1975). The site has a fine-sediment matrix, the upper meter or so of which contains the remains of human occupations spanning the last 1,000 or 1,500 years. On the basis of ethnohistorical information, the final occupations are attributed to the Kutchin-speaking Indians, ancestors of the residents of Old Crow who still occupy the northern Yukon Territory (Morlan, 1975).

Paleozoological finds are common in excavations or exposures along the Old Crow River. Bones collected in sediments have been radiocarbon-dated at over 40,000 years old, and have indicated the former existence in the northern Yukon of giant beavers (up to 3 m long and weighing up to 200 kg), mammoths, large horses, American lion, caribou, and camels (Harington, 1971). Insect fossils dated to more than 40,000 years old have also been recovered in this area. One of these insect species is no longer found in the Old Crow Basin (Matthews, 1975).

In addition to being a refugium for animals, the northern Yukon also served as a refugium for plants. The present biota of Arctic Canada was thus directly influenced by the biota of these areas during glacial times. The northern limit of trees in Canada is within this area, making it an important area for documenting past fluctuations in boreal biota. Plant macrofossils recovered at two exposures in the Old Crow - Porcupine region have been radiocarbon-dated at 32,400 years (in the Bluefish Basin on the Porcupine River) and 44,000 years (in the Old Crow Basin). Both assemblages seem to have been deposited when the sites from which they came were within a region of forest-tundra. The Porcupine River assemblage indicates that the tree line along the middle Porcupine drainage during mid-Wisconsin time was considerably lower than at present; more northern areas, such as the Old Crow Basin, would have been totally treeless in contrast with the forest-tundra vegetation there today. The Old Crow assemblage probably represents climatic conditions as warm as at present (Matthews, 1975).

SOCIAL-CULTURAL SIGNIFICANCE

In addition to its archaeological and historical significance, the Old Crow Basin Ecoregion (roughly 11,000 km^2) is considered by the International Biological Program (IBP) to be important for research dealing with the relationship between game and furbearing animals and humans who utilize them almost exclusively for their livelihood (Beckel, 1975). The indigenous people are an integral part of the biological complex -- they have harvested the wildlife and fish of the Old Crow Basin for scores of generations.

EDUCATIONAL AND RESEARCH VALUE

The northern Yukon study area, with a total area of roughly 35,000 km^2, has almost limitless potential for research and educational purposes. It has a great variety of physical and biological phenomena, and a multitude of outstanding phenomena which have been previously discussed. As such, the area may be one of the most important in Canada for studies aimed at advancing knowledge concerning geology, geomorphological processes, glaciation, climate, vegetation, wildlife, paleontology, archaeology, etc. of Arctic Canada and Canada as a whole.

PRISTINE QUALITY OF THE NORTHERN YUKON

The study area, except for the DEW Line sites at Komakuk Beach and Shingle Point, has no permanent inhabitants, and compared with many other arctic areas has been relatively undisturbed. Many of the existing signs of disturbance, such as seismic lines and winter exploration roads, mostly from the late 1960's, are barely visible now and will soon be barely detectable. The pristine quality of the area has thus been largely preserved. In addition, as essentially all watercourses in the northern Yukon originate within it, and since there is only ocean to the northwest (the direction of prevailing wind), the chances of environmental contamination being brought into the area from outside are low.

The lack of pesticides and petroleum pollutants and the virtual absence of man in the northern Yukon favour the successful rearing of young by many animals, such as the threatened peregrine falcon.

SECTION G

RECENT HISTORY OF MAN IN THE NORTHERN YUKON

The recent history of man in the northern Yukon centers on the Kutchin Indians, who settled along the Porcupine drainage system, and on explorers, whalers, mounted police, and Eskimos who frequented coastal areas, especially Herschel Island.

KUTCHIN INDIANS

The Kutchin Indians (now known as Loucheux) traditionally fished for salmon and freshwater fish in summer and hunted moose, caribou, hare, and other game in winter (Harding, 1976). During spring and fall, they hunted migrating caribou at river crossings. In the British Mountains, they also funnelled caribou into corrals via long fences of spruce trees (remains of several Kutchin fences still exist, some of which are over 3 km long and built of thousands of stunted spruce trees). This subsistence life-style changed very little throughout the prehistoric periods.

The period from around 1870 included the abandonment of Klo-kut, a site located on the north bank of the Porcupine River about 10 km upstream from the village of Old Crow (Morlan, 1975). During the brief gold rush period at the turn-of-the-century, many Kutchin Indians went south to trade meat to the miners. When the rush ended, many moved to the Mackenzie Delta to trap muskrats near the trading posts; most of the remaining Indians began to gather at the junction of the Porcupine and Old Crow rivers, a traditional river crossing for migrating caribou and, for years, the site of a hunting camp (Harding, 1976). Here the present village of Old Crow developed.

Old Crow is presently the most northerly permanent settlement in the Yukon Territory. It is home to over 200 Loucheux Indians who live mainly by fishing, hunting, and trapping. Fish catches, which may reach 10,000 salmon and 3,000 freshwater fish annually, continue to be important in the Loucheux culture (Harding, 1976). Besides their use for human consumption, fish are the principal food for sled dogs, which provide winter transportation for hunting and trapping. Caribou, moose, and waterfowl also provide food for the Old Crow people. 'Ratting', the annual spring muskrat hunt on the Old Crow Flats, is also important as it provides cash from the sale of fur. Furs of fox, lynx, mink, marten, and wolverine are also sold. The annual muskrat hunt is also very important to the Old Crow people as it has traditionally been a family outing where young and old work and live together outdoors in the Flats. The continuance of this traditional subsistence way of life of the Old Crow residents indeed depends heavily on the northern Yukon's wildlife resources and the ecosystems which they inhabit.

HERSCHEL ISLAND

Herschel Island is a 112 km^2 mound of tundra-covered glacier-disturbed marine deposits, located roughly 1.5 km off the coast of the northern Yukon. It was the first part of the Yukon to be discovered by white men. Sir John Franklin visited the island during his second overland expedition of 1825-28; he named the island after Sir John Frederick William Herschel, a noted astronomer and chemist.

Being the only major island along the Arctic coast west of the Northwest Territories, Herschel became the important summer base for lucrative arctic whaling operations in the late 19th century when baleen (flexible whalebone used for corset stays) demanded premium prices. Whaling vessels first reached Herschel Island in 1889; for many winters onward, whalers anchored on the south shore in Pauline Cove, a natural harbour protected from the movement of ice and the north winds (Stevenson, 1968a). The island was also visited by seekers of the Northwest Passage, such as the Norwegian explorer Amundsen in 1905-06 and Larsen of the *St. Roch* in 1926-27.

Herschel Island became the first locale where Canada expressed sovereignty in the North. In 1903, the North West Mounted Police established a detachment, at that time the most northerly in the country. This act was in response to pressures from missionaries and others wanting law and order, and to the fact that every ship's masthead flew the Star Spangled Banner, giving the island the appearance of an American community. The two policemen attached to the post were charged with enforcing the laws of Canada and asserting Canada's sovereignty. As well, they had instructions to inspect cargoes of the whaling vessels, to collect any taxes and customs duties, and to confiscate all illicit liquor.

In 1906, the price of baleen had fallen to less than one-twelfth of its 1889 value, and the bonanza which had netted the fleet $14 million during the boom years was over (Stevenson, 1969). The island became a trading post, and in 1915 the Hudson Bay Company established on the island a transshipping point, headquarters of its Western Arctic Division; however, when the company decided to move its transportation center to Tuktoyaktuk in 1938, Herschel Island declined further. The missionaries and remaining Eskimos left shortly after, and in August 1965 the RCMP lowered the flag and closed the detachment. Today, although a few

vessels still occasionally overwinter in Pauline Cove, only the remains of the Eskimo houses and other buildings, and a few grave markers, recall the wilder, more romantic days of the turn-of-the-century.

SECTION H

WILDLIFE

INTRODUCTION

The northern Yukon is perhaps the most diverse and productive area of Canada's Arctic. It supports many wildlife species in a wide range of habitats. Here we shall discuss those wildlife species for which sufficient data are available as well as their use of land ecosystems within the study area. Information was taken primarily from studies concerned with the potential environmental impact of petroleum exploration and pipeline construction in the northern Yukon. Emphasis was placed on extracting that which dealt with wildlife distribution and abundance and the definition of habitats within the study area.

Two points must be kept in mind if we are to understand the wildlife of the northern Yukon. Firstly, the northern Yukon was part of the Beringian Refugium (or Beringia); it was an unglaciated haven for plants and animals during the Wisconsin glaciation which, in North America, included the majority of Alaska, the Yukon, and part of the District of Mackenzie (Youngman, 1975). Secondly, the northern Yukon presently has long, severe winters and short yet productive summers.

The glacial history of the area was largely responsible for the present faunal structure. Youngman (1975) describes the present mammalian fauna of the Yukon as follows:

> "Approximately 33 percent of the terrestrial mammal fauna of the Yukon are Beringian in origin, whereas about 6 percent are post glacial immigrants from the south. The remainder are thought to be from other refugia, or are introduced species."

This unique situation is further influenced by the present day climate which, to a large degree, dictates the habitats available for exploitation by the permanent and seasonally resident wildlife species. The influence of these climatic conditions is probably best exemplified in the effects of permafrost on the land. The depth of the active layer (ie unfrozen soil) dictates the type and productivity of the vegetation cover. This is most remarkable in riparian and shoreline situations where the active layer is relatively deep and the development of tree and shrub vegetation stands out in striking contrast with the surrounding tundra or mountain slopes. Such riparian and shoreline situations provide food and cover for many animals such as moose, various small mammals, and waterfowl. The depth of the active layer also influences the activities of burrowing species such as arctic fox and arctic ground squirrel.

BARREN GROUND CARIBOU

Because of its migratory behaviour, the barren ground caribou's (Rangifer tarandus) habitat in the northern Yukon varies throughout the year. Caribou habitat is best envisioned as a collection of different areas, each important for different reasons at different times. These areas have been classified on the basis of the purpose they serve -- winter range, staging areas, river crossings, mineral licks, calving grounds, and migration corridors (cf. McCourt et al., 1972; Watson et al., 1973; Jakimchuck et al., 1974; and Surrendi and Debock, 1976). Each of these areas is vital to the herd's survival as the following summary of the Porcupine herd's yearly cycle will indicate.

During the winter the Porcupine herd is dispersed over a wide area of the northern Yukon and adjacent Alaska. The most extensively used areas (Figure H1) are south of the Porcupine River and include parts of the Keele, Ogilvie, Richardson, and Wernecke mountains. Other major wintering areas are the vicinity of Arctic Village in Alaska and the Yukon-N.W.T. border northeast of the Porcupine River in the Richardson Mountains. Besides these areas, parts of the herd have been known also to winter on the treeless Old Crow Flats and on the Northern Coastal Plain.

Preferred winter habitat in this area is reported to be mature spruce-lichen (taiga) forest which provides both food and shelter. Jakimchuck et al. (1974) noted that animals wintering in lowland areas tended to frequent river margins with good sedge growth. Caribou wintering in upland areas tended to move to higher, more rugged, but lichen-covered slopes as spring approached. This may have been a response to food shortage at lower elevations or a function of the tendency to congregate on wind-blown ridges during spring staging.

Staging occurs in both spring and fall. This respectively facilitates the grouping of the caribou for migration to calving grounds and to wintering grounds. Some of the staging areas identified for the Porcupine herd are shown in Figure H1. Spring staging habitat is described as windswept ridges and hill crests which have little or no snow cover; the caribou appear to avoid the deeper snow in the valleys and on the lower side slopes of mountains at this time of year. Assessing the contentions of several authors Surrendi and Debock (1976) note that the windswept north/south-oriented ridges and crests of the Richardson Mountains, which extend from the Peel River to the Arctic coast, may facilitate the orientation and movement of caribou using this route.

The spring migration routes run close to the eastern and western boundaries of the Yukon. The easterly or Richardson route runs from the Peel River drainage north through the Richardson Mountains veering west towards the calving grounds, located in the extreme northwest of the territory, crossing the Blow River near the interface of the Northern Coastal Plain and the Northern Mountains ecoregions (Figure H1). The western route begins in the Ogilvie Mountains and Keele Range south of the Porcupine River. The caribou cross the Porcupine near the village of Old Crow; at this point, some animals veer west into Alaska and then bear north again towards the Northern Coastal Plain. The rest continue north across the Old Crow Flats and through the British Mountains (Figure H1).

The calving grounds, the terminus of the spring migration, are a critical part of the caribou's range due to the sensitivity of the caribou to disturbance during the calving period and the specialized, restricted area used. The calving grounds of the Porcupine herd are located in the northwestern corner of the Yukon and extend into northwestern Alaska along the Northern Coastal Plain. The major calving concentrations coincide closely with the Komakuk Plains Ecodistrict and with the inland Buckland Basin, Upper Trail River, Mt. Sedgwick, and Tulugaq Pediments ecodistricts. In addition, areas in the foothills of the Barn Range towards the headwaters of the Babbage River have importance (Figure H1). Numerous authors have identified other calving concentrations of various sizes and have drawn maps showing various portions of the Yukon's northeastern corner as calving grounds. The calving grounds of the Porcupine herd cannot be precisely delineated, however, and vary to some degree from year to year. The exact timing of parturition probably varies somewhat among cows as would the quality of the calving habitat and the timing of the spring migration, the latter two heavily dependent on spring weather. These factors could well account for the observed variation in the year-to-year location of calving concentrations. The calving grounds are characterized by gently rolling hills and valleys. The areas are free of snow, well-drained, and sheltered, with good growths of cottongrass, the preferred food at this time (Lent, 1966). Furthermore, of the six mineral licks located by Surrendi and Debock (1976), four were closely associated with the calving areas defined by these authors. They note that these licks were heavily exploited by lactating cows and sub-adult caribou.

The majority of calving is completed in the first two weeks of June. After this, the herd forms large, dense post-calving herds and

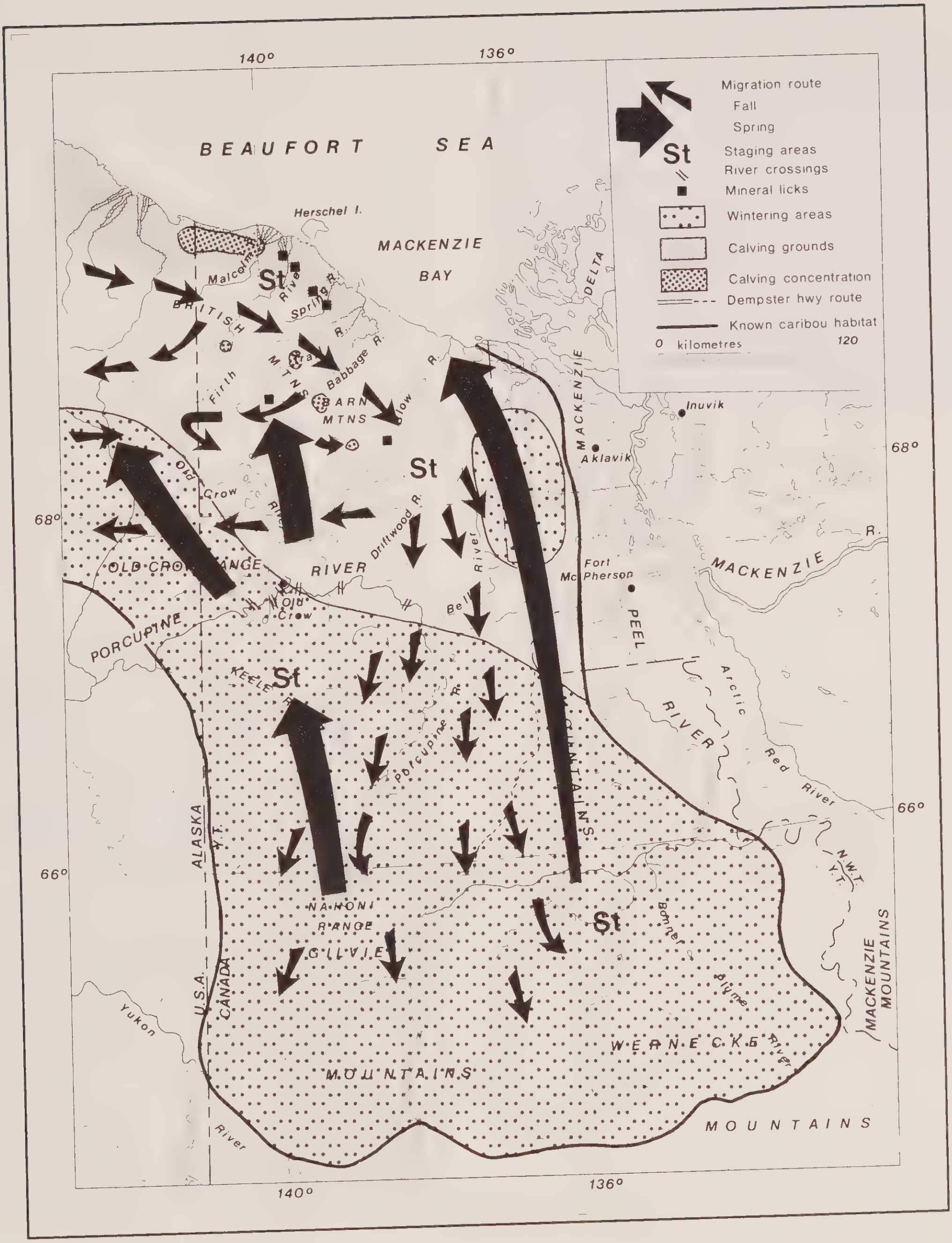


Figure H1: Generalized habitats of the Porcupine caribou herd

continues to move throughout late June, July, and August. These summer wanderings are very variable. However, research to date suggests that these wanderings involve movement from the coastal calving areas, in Alaska and the northwestern Yukon, southwest to a staging area around Bonnet Lake among the headwaters of the Blow, Driftwood, and Bell rivers and Johnson Creek. Then, at the end of July and the beginning of August, the caribou return to Alaska moving west across the Old Crow Flats.

Several reasons for this continuous movement pattern have been proposed. Lent (1966) and Skoog (1968) suggested it as directional move ment to summer ranges. Lent (1966) enlarged upon this by contending that such large aggregations must move or deplete their food supply. Pruitt (1960), however, considers this movement directly related to insect harassment. Indeed, it is during this part of the summer that the caribou are subjected to the most severe insect harassment. This affects both the behaviour and habitat selection of the animals. Some authors have suggested that compact herd formations assist in combatting insect harassment (Skoog, 1968; Kelsall, 1968). However, Bergerud (1974) and Skoog (1968) noted that when forest cover was available, caribou would disperse into the trees to seek relief from the insects. Bergerud (1974) has listed behavioural responses by different populations of caribou correlated with the kind of insect relief habitat available:

Habitat Type	Caribou Behaviour
Forest cover	Sedentary small aggregations
No forest cover, but windswept ridges	Moderate size yet quite sedentary herds
No forest cover, discontinuous wind-swept terrain	Large herds in con-tinuous movement

The last of these appears to describe the situation and behaviour of the Porcupine herd.

Subsequent to the late summer movement into Alaska comes the migration to winter habitats. This movement is under way by late August or early September. Those animals returning to the Yukon move west through the southern portions of the Northern Mountains and Old Crow Basin ecoregions. Surrendi and Debock (1976) distinguish three 'waves' of caribou movement during this period. Each was larger and moving more rapidly than its predecessor, the later waves apparently being driven by September blizzards. The caribou turn south and move through the Old Crow Flats or the intermontane area west of the Richardson Mountains. Some, however, may move into the wintering area in the northern Richardson Mountains along the Yukon-N.W.T. border west of Aklavik and Fort McPherson. The majority of the animals cross the Porcupine at various traditional points Figure H1) and disperse into the wintering areas around the Ogilvie, Wernecke, and southern portion of the Richardson Mountains.

If nothing else, the foregoing outline of the yearly cycle of the Porcupine caribou herd indicates the vast area required for its maintenance and well-being. The important events and areas mentioned and depicted represent vital links in the chain of events followed by the herd each year. Furthermore, the areas and migration paths used by the caribou are not static from year to year but vary. Disruption or interference with any one of these events, areas, or paths will result in uipredictable consequences for the survival of the herd. Even now, the effect of the Dempster highway, which transects both the caribou's winter range and migration routes, is unknown. because this highway is fait accompli, the response of the caribou to it should be monitored now before it comes into year-round use.

Plate H1: Portion of the Porcupine herd on a cryoplanation terrace in the Upper Trail River Ecodistrict

BEARS

The northern Yukon is the sole area where our three native bears -- grizzly, polar, and black -- range within the same general territory. The grizzly (Ursus arctos) ranges throughout the Northern Mountains, and, occasionally, onto the Northern Coastal Plain and the Old Crow Flats. In winter, the polar bear (Ursus maritimus) hunts seals on the sea ice off the north coast of the Yukon and, on occasion, ranges further inland. The black bear (Ursus americanus) frequents the well-forested river margins of the Old Crow Flats (Calef, 1974).

a) Grizzly Bear

The most common and widespread of these three species in the study area is the grizzly. A highly adaptable species, the grizzly bear exploits a wide range of habitats in western and northern Canada. Pearson (1977) in extensive research on Canadian grizzlies has defined nine 'ecotypes' of grizzly in western and northern Canada, of which one, termed the Arctic mountain grizzly, occupies the study area.

The most important habitat for grizzly in the study area appears to be in the Northern Mountains Ecoregion (Figure H2). Analysis of data from aerial surveys done by Ruttan (1972) and Doll et al. (1974) revealed that at least 60% of all grizzly observations were made in this area. Considerably fewer observations (20%) were made in the Northern Coastal Plain and Old Crow Basin ecoregions. In a recent study of grizzlies in the Barn Range of the Northern Mountains Ecoregion, Pearson (1974) estimated the grizzly population density to be roughly one animal per 64 km^2.

The Northern Mountains also provide winter denning habitat for these bears. Pearson (1974) found and examined 12 active dens in the Barn Range. The dens were found at elevations ranging from 426 to 1,036 m with the majority (7 of 12) located on warmer south-facing slopes. This may well be associated with the depth of the active layer on these slopes which, in turn, affects the ease and depth to which the bears can dig.

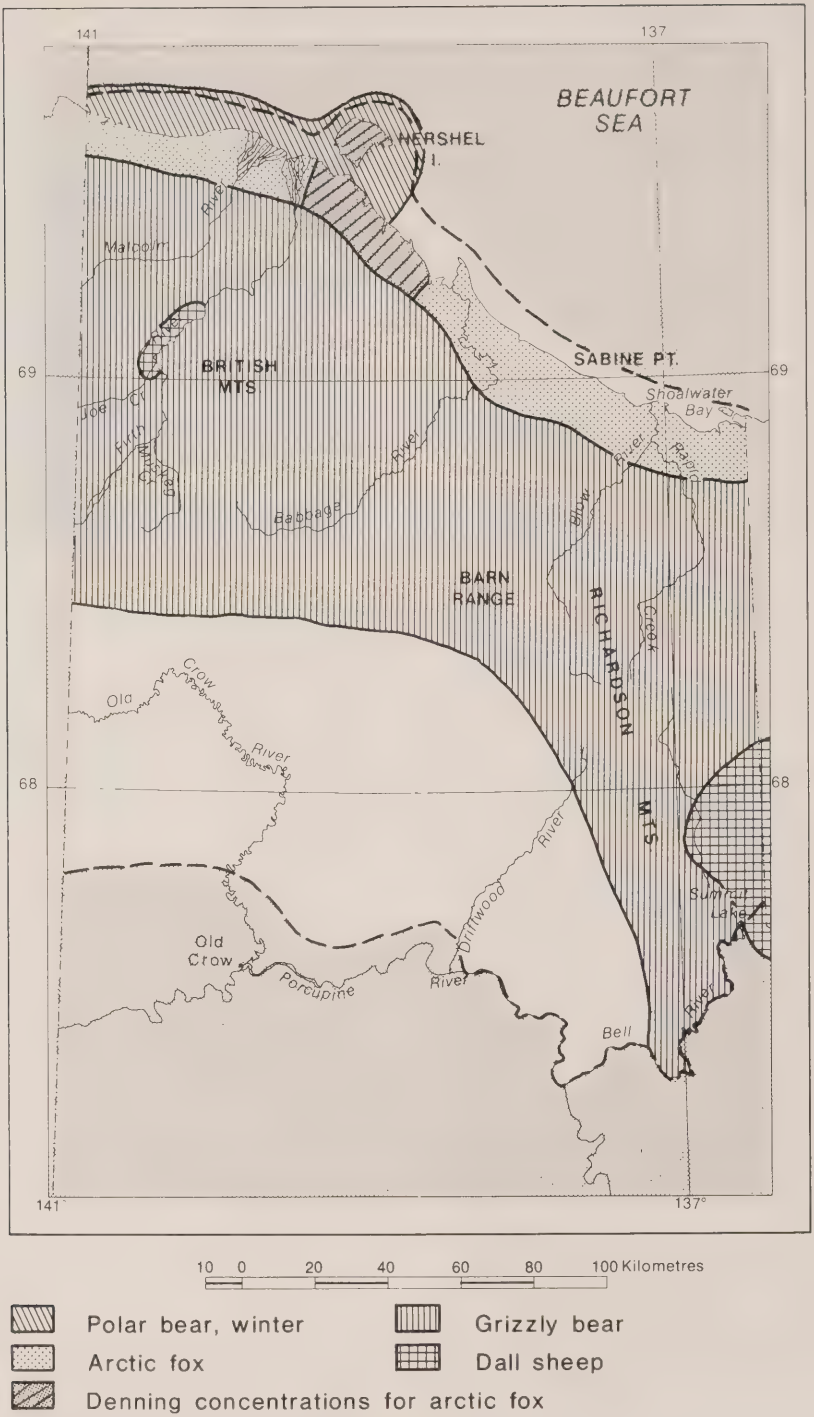
Grizzlies are primarily herbivorous. In the northern Yukon, the bulk of their diet is made up of roots, berries, and grasses (Pearson 1977). The proportion of meat in their diet on a yearly basis is low (roughly 10%) and is usually gleaned by scavenging wolf-killed caribou. However, arctic ground squirrels are actively sought in the fall.

Plate H2: Female grizzly and cubs in the Babbage Plains Ecodistrict.

b) Polar Bear

Primary polar bear habitat in the study area is shown in Figure H2 and corresponds to the area of high polar bear use defined by the Northern Land Use Information Map series. Polar bears are rare along the coast during the open-water period but become common later in the year as the southerly drifting pack ice from the arctic islands joins the newly formed sea ice along the coast (Watson et al., 1973). The bears are then generally abundant until spring breakup. Records of bears moving further inland are rare. Youngman (1975) cites two unconfirmed reports from as far south as the Porcupine River. In other areas, the polar bears moving inland are females searching out suitable maternal den sites for the winter. Denning along the Yukon coast is rare, however. The only record of a den in the recent past is from Herschel Island (Watson et al., 1973). Polar bear use of the area outlined in Figure H2 may be related to the availability of seals as food. Aerial surveys by Moore (1976) showed ringed seals distributed along the Yukon coast, with the greatest densities in coastal areas of the Komakuk Plains and Herschel Island ecodistricts.

Further east, near Shingle Point, population densities were low. Moore suggested that the higher seal densities around the Komakuk Beach and Herschel Island area were due to the activity of sea currents which, in the Herschel Island area, caused deformation and ice leads to open thus allowing seals easier access to the surface.



<u>Figure H2</u>: Primary habitats for selected mammals

A further incentive for seals to frequent the area may be related to the fact that both the Firth and Malcolm rivers enter the Beaufort Sea just west of Herschel Island. Nutrient loads carried by these large rivers may result in a productive invertebrate fauna which would support fish populations and, in turn, attract the seals.

c) Black Bear

Little information is available on the distribution and abundance of black bears in the northern Yukon. Based on Calef's 1974 notes, they frequent the taiga ecotone of the Old Crow Basin Ecoregion. Doll et al. (1974) further reported the localities of 12 bears they observed in 1972 and 1973 surveys, noting that most of these sitings were made near the Old Crow and Porcupine rivers. Since black bears prefer to inhabit the boreal forest to the south of the study area, the taiga ecotone may represent the northern fringe of the black bear's distribution in the Yukon.

DALL SHEEP

There are two disjunct populations of Dall sheep (*Ovis nivicola dalli*) in the northern Yukon; unlike their caribou relatives, these populations occupy a more restricted habitat. One group, consisting of close to 500 animals (Watson et al., 1973), occupies an area centered around Mount Goodenough, N.W.T., but extends west across the Yukon-N.W.T. border into the Richardson Mountains. The second group (100 animals) occupies parts of the Joe Creek, British Mountains, and Malcolm River ecodistricts west of the Firth River (Figure H2). From recorded movements, this group is considered to be the easterly extension of a large population centered in the Brooks Range, Alaska.

Critical habitat areas for these sheep are their wintering and lambing areas and their mineral licks (Nolan and Kelsall, 1977; Watson et al., 1973). Most of these habitats as well as their summer range are associated with the alpine tundra or barrens of the Northern Mountains Ecoregion. Here the relationships of rocky crags, steep colluvial slopes, geologic materials, vegetation, and climate are significant in sustaining sheep populations. Winter habitats in the Mount Goodenough area are characterized by Nolan and Kelsall (1977) as reasonably well-vegetated slopes, ridges, and plateaux exposed to prevailing winds which keep the snow-free. These areas are between 500 and 915 m in altitude and are near suitable escape terrain in the form of steep slopes. The sheep move onto their winter ranges in mid-October and stay there until early May when lambing begins. It appears that, in the vicinity of Mount Goodenough at least, the ewes remain in the wintering habitats for lambing while the rams move west (in early May) into the Richardson Mountains. Rams concentrate around mineral licks where the ewe/lamb groups join them after lambing is complete in mid-June (Nolan and Kelsall, 1977).

The summer distribution of Dall sheep seems to center on the various mineral licks; their altitudinal distribution may be mediated by insect harassment. Nolan and Kelsall (1977) found that one group, instead of feeding on the well-vegetated slopes surrounding a mineral lick in the Richardson Mountains, moved up onto high colluvial slopes to feed where insects were less numerous, perhaps owing to the cooler air temperatures and the increased exposure to winds.

Little research has been done on the population of Dall sheep in the British Mountains as they were unlikely to be affected by any proposed pipeline construction. However, the work done on the sheep in the vicinity of Mount Good-enough can be extrapolated to the British Mountains group. Preliminary observations (Nolan and Kelsall, 1977) of the behaviour of this group indicates that summer distribution of these sheep is centered around two mineral licks on the west bank of the Firth River in the British Mountains Ecodistrict. Further studies are required to document the distribu tion, behaviour, and population status of this most northerly population of Canadian Dall sheep.

Beyond habitat considerations, the Mount Goodenough herd needs management. Hunting pressure and natural mortality remove so many animals that annual lamb production barely serves to maintain the present population level. Simmons (1973) states that this herd, although located in good habitat, is in danger of overharvest.

ARCTIC FOX

Arctic fox (*Alopex lagopus*) are common throughout the arctic tundra of North America and Eurasia. Their general distribution in the Yukon extends from the Porcupine River north to the Arctic Coast (Youngman, 1975; Banfield, 1974). However, based on summer mapping of den sites (Ruttan, 1972; Watson et al., 1973), the primary arctic fox habitat is found along the Northern Coastal Plain (Figure H2). More specificaly, they are associated with the Herschel Island and King Plains ecodistricts.

Availability of suitable denning habitat for breeding appears important for these animals. Various authors (Macpherson, 1969; Ruttan, 1972; Watson et al., 1975; and Banfield, 1974) indicate that fox dens are dug in open, well-drained areas with easily excavated surface materials, often near water. Surveys in the study area (Ruttan, 1972; Watson et al., 1973) revealed that the greatest concentration of active and inactive fox dens was located on th Northern Coastal Plain between the Firth and Spring rivers and on Herschel Island. Correlating known den site locations (Ruttan, 1972) with a detailed surficial geology map of the area and with aerial photographs revealed that the majority of fox dens (28 of 35) were located in riparian habitats (ie near or on lake shores or river and stream banks) and virtually all were associated with fine-textured surficial deposits.

After reproductive activity ceases and during the winter, both adult and young foxes dispers over a larger area. The extent of their distribution probably depends heavily on food availability.

Scarcity of food, especially during the winter months, could well result in a more diffuse distribution. Arctic fox are known to follow wolf and polar bear and scavenge their kills, especially during the winter when food is difficult to obtain. Food availability, mainl in the form of lemmings, is also critical to the reproductive performance of these animals. Studies in other areas (Macpherson, 1969) indicate that the cyclic highs in arctic fox populations are correlated with high lemming populations. In the northern Yukon, approximately 90% of their diet can be comprised of lemmings (summer data from Ruttan 1972). The lemmings themselves prefer the wetter tundra-covered sites and riparian locales for habitat. Here, sedges provide an important food source.

In years of low lemming populations, Banfield (1974) notes, the February-April mating period of the fox may be curtailed or missed completely with resulting poor reproductive success. Thus, arctic fox populations in the northern Yukon are dependent on good quality denning habitat along the Northern Coastal Plain and viable lemming populations in the same area. This, in turn, means that lemming habitat must not be degraded.

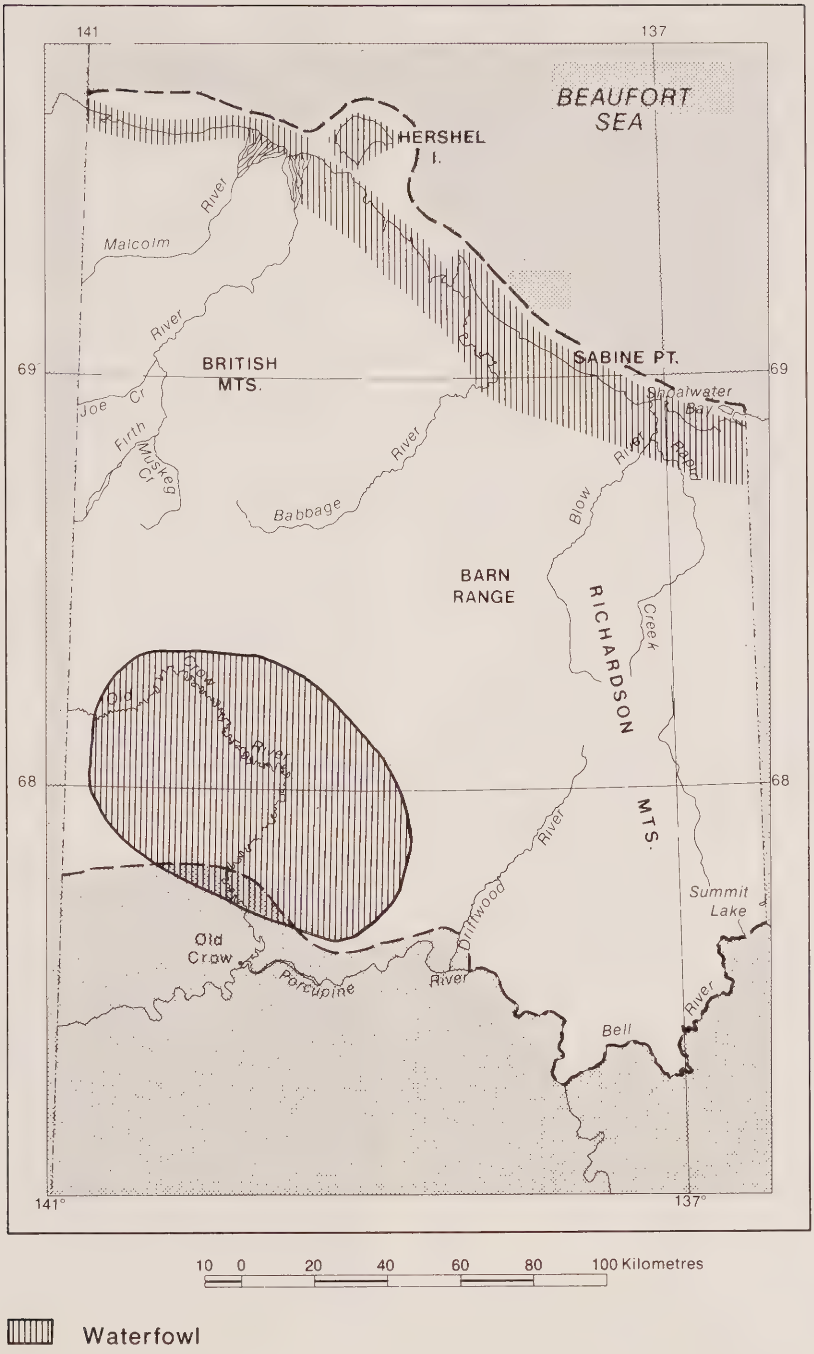
WATERFOWL

While the main emphasis here is on waterfowl habitat, areas of concern to shorebirds and other birds are also noted. Two major and geographically separated areas in the northern Yukon are important to waterfowl and shorebirds: the Northern Coastal Plain Ecoregion and the Old Crow Flats Ecodistrict (Figure H3). These two areas are approximately 120 km apart, lying on either side of the mountainous divide of the Northern Mountains Ecoregion.

Within the Northern Coastal Plain, the shore zone and inland water bodies are particularly significant. The peninsulas, barrier beaches, lagoons, spits, river deltas and islands, and sandbars along the coastline are used as moult ing areas during the early summer by a large number of sea ducks. Herschel Island, for example, supports a population of roughly 10,000 sea ducks during the moulting period (Gollop and Davis, 1974). At other times of the year, such as the late summer and fall, the same shore zone areas are used as staging grounds for ducks, geese, loons, and shore birds. The coastal area and the lowermost reaches of rivers from the mouth of the Blow River west to the Canning River in Alaska are, in particular, the fall staging grounds for several hundred thousand Snow Geese as well as smaller populations of Black Brant, White-fronted Geese and Canada Geese, and Whistling Swans (Koski, 1975; Schweinsburg, 1974). From the delta areas, these birds range inland to the foothills of the Northern Mountains where they feed on sedges and berries in preparation for the long southward migration (Koski, 1975; W. Speller, pers. comm.).

Inland from the coastline proper, the shallow lakes of the King Plains Ecodistrict are the feeding and breeding habitat for waterfowl, loons, and shorebirds. In a survey of 22 lakes, Gollop and Davis (1974) found that 14 supported broods of waterfowl. Of the surveyed lakes, the larger-sized supported more shore birds and Arctic Terns and had a generally greater species diversity. The productivity of shoreline vegetation and the slope of the lake foreshore determined the suitability of these lakes for waterfowl and shorebirds. Lakes having productive riparian vegetation and gently sloping banks were most suitable for these birds.

The Northern Coastal Plain Ecoregion is part of a major two-way migration corridor. Observa tions at Nunaluk Spit in the Komakuk Plains Ecodistrict revealed that well over 200,000 birds of 58 species migrated past this location alone. The peak time for these birds was the interval between 21 August and 10 September (Gollop and Davis, 1974). From other studies (Schweinsburg, 1974), the species using this corridor have been estimated as: 32% waterfowl, 31% shorebirds, 18% gulls and terns, 14%



<u>Figure H3</u>: Primary waterfowl habitats

Lapland Longspur and other songbirds, and 5% other birds. These figures indicate the diversity of species which migrate through this region.

In contrast with the Northern Coastal Plain Ecoregion, the Old Crow Flats Ecodistrict occupies the floor of an interior basin. This ecodistrict is a lake-dominated surface; it provides nesting, feeding, moulting, and staging habitat for thousands of waterfowl and shorebirds. As in the King Plains Ecodistrict, the lakes most heavily used by waterfowl are those possessing the most favourable combination of shoreline topography and vegetation. With respect to its importance to waterfowl populations, this area is on an equal footing with the Northern Coastal Plain and the Mackenzie Delta areas. Its major function is in providing habitat for large numbers of surface feeding and diving ducks. Upwards of 300,000 breeding pairs nest here. In addition, large numbers of non-breeding ducks also exploit the Old Crow Flats. During drought years on the prairies, the number of ducks on the Flats can double (G. Cooch, pers. comm.), thus giving the area an even greater role in maintaining national and international waterfowl populations.

OTHER WILDLIFE

Based on observations and sightings from other studies, moose (Alces alces) are most commonly found throughout the Old Crow Flats Ecodistrict. This area possesses summer and winter habitat and supports the largest concentrations of moose within the study's limits. The Flats proper are exploited mostly in the summer. Here, the numerous shallow lakes provide a variety of aquatic weeds and a refuge from insects. On the ground surfaces which form the net-like framework for the lakes, extensive shrub growth generates preferred browse such as willow, birch, and balsam poplar. Overwintering areas are less extensive and the moose would likely be restricted as to suitable habitat. Because of the shelter and the higher forms of shrubs, the semi-treed locales of the incised river valleys, such as the Old Crow River, would receive greater use in winter. Having limited extent, these particular winter habitats warrant greater concern in relation to possible disturbance by man.

While their numbers are comparatively smaller, moose have also been sighted within the Northern Mountains and the Northern Coastal Plain ecoregions. The locations, however, are more site-specific, being confined primarily to the narrow, shrub-covered land which lies adjacent adjacent to major streams and rivers. Because these habitats are few and small in both ecoregions, the carrying capacity for moose is relatively low. These habitats are interesting in that they represent 'outlier' land ecosystems. Even though the majority of these land ecosystems are not mapped, they would correspond mainly to either 'ecosections' or 'ecosites' within the ecological land classification system. They are distinct forms of land ecosystems because their traits are more representative of the milieu which characterizes parts of the Old Crow Basin Ecoregion. They occur in these two ecoregions because of their position on the land's surface -- in this case, a position which is warmer and drier than the surrounding and more dominating environs. As a consequence, biological and physical characteristics more akin to the taiga ecotone further to the south develop. Similarly, the moose inhabiting these land ecosystems are themselves 'outliers' -- that is, they are isolated members of or 'stringers' from a much larger population and are in themselves not well-suited to the dominant controls which prevail over the larger natural setting.

Within the study area, muskrat (Ondatra zibethicus) are also most common in the Old Crow Flats Ecodistrict. Their presence has been associated with those lakes having a productive aquatic weed community and an irregular and abrupt shoreline (Watson et al., 1973). Equally, water depths probably play a role in determining muskrat distribution. Extremely shallow lakes would freeze to the bottom in winter, thus preventing muskrat movement beneath the ice. Measurements by Ruttan (1972) on some of these lakes show that ice thickness can reach 100 cm. Thus, lakes less than a meter in depth would not be reliable winter habitats for muskrat. Water quality can also be important. Watson et al., (1973) state that turbid, shallow lakes are avoided by muskrat whereas clear, deep lakes are favoured. Unfortunately, data or information concerning these lakes are for the most part conspicuously absent to allow definitive habitat interpretations. These rodents appear to be quite abundant in the Old Crow Flats; however, a reliable assessment of their populace is not available. They are subject to some harvesting pressure by the residents of Old Crow who go 'ratting' each spring.

Like muskrat, beaver (Castor canadensis) are associated with the waterscape of the Old Crow Flats Ecodistrict. Numerically, they are not as common as muskrat. According to Watson et al. (1973), their distribution and abundance is probably limited by the distribution and abundance of deciduous trees. Since these

trees serve as food sources and construction materials and since these particular plant species do not frequently occur over the Flats, a limited beaver population would be expected. In addition, gravelly stream beds, unstable banks, and widely fluctuating water levels in these lakes and streams were considered by Watson to provide less than optimal conditions for beavers.

In an attempt to reintroduce muskox (Ovibos moschatus) to Alaska's north coast, a total of 64 muskox were released near Barter Island and Kavik Camp, Alaska, in 1969-70 (Roseneau and Stern, 1974). Since then, some of these animals moved along the north coast into the northern Yukon. Sightings are rare, but a handful of animals appear to be using the Northern Coastal Plain. The largest group observed, numbering six animals, was found near Spring River in 1973 (Roseneau and Warbelow, 1975) but moved farther east and near King Point where four were shot by natives (N. Novakowski, pers. comm.). Although one lone bull was sighted as far south as the southeastern edge of the Old Crow Flats, the muskox seem to be using the tussock tundra of the Northern Coastal Plain. Whether these few animals can form the nucleus of a viable Alaskan-Yukon population is debatable. Until this can be ascertained, these animals must be monitored with minimal harassment and protected from human interference. Furthermore, their potential interaction with the Porcupine caribou herd on their calving grounds must be considered.

Plate H3: Rarely seen muskoxen

Doll et al. (1974b) and Jakimchuck et al. (1974) have estimated that 300 to 400 wolves (Canis Lupus) range between the Peel River and the Beaufort Sea in the northern Yukon. Information on these animals is scarce and exists only as a collection of incidental observations made in conjunction with other wildlife surveys in the study area. As might be expected, the interaction between the wolves and the Porcupine caribou herd is significant. Doll et al. (1974b) note that 20% of 154 wolf observations were associated with caribou in some fashion (ie hunting, attacking, or feeding). The hunting tactics of wolves are somewhat associated with caribou habitat; they rely on ambush along forest trails and at river crossings. Caribou are also chased into deep snow or onto clear lake-ice where they are at a disadvantage (Jakimchuck et al., 1974).

Distribution and abundance data for wolves in the northern Yukon are inadequate. Average pack sizes have been estimated at two or three by Doll et al., (1974b); Jakimchuck et al., (1974); however, the latter authors recorded a pack of 14 wolves in the Old Crow Flats in April 1971. Judging from wolf studies else where (cf. Kuyt, 1972), the wolves probably follow caribou movements when not engaged in denning or caring for pups. Thus, wolf distribution in the non-breeding season may well be closely correlated with caribou distributions. However, such speculation needs confirmation from adequate field studies. Such studies are sorely needed, especially in terms of the impact of wolves on the Porcupine herd if rational management decisions concerning both species are to be made.

Several species of raptors inhabit the northern Yukon, including the Golden Eagle, Peregrine Falcon, Gyrfalcon, Rough-legged Hawk, Pigeon Hawk, and Osprey. The Peregrine Falcon, Gyrfalcon, and Golden Eagle are cliff nesters. The crags, residual pinnacles, and tors of the Northern Mountains Ecoregion provide good perching and nesting habitat while the open intermontane areas, and the plains of the coast and the interior basin, provide good foraging habitat for these birds. The Pigeon Hawk, Rough-legged Hawk, and Osprey are characteristic of better forested habitat where they are usually tree nesters; thus, they are inhabitants of the Old Crow Basin Ecoregion and treed areas along major rivers.

SECTION I

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SECTION J

APPENDICES

APPENDIX 1: VASCULARS, BRYOPHYTES, AND LICHENS IDENTIFIED FOR THE NORTHERN YUKON

A) Vascular Species -- arranged in phylogenetic order according to Hultén, 1968; authorities also from Hultén, 1968.

Species and Authority	Common Name
Selaginellaceae (Spikemoss family)	
Selaginella sibirica (Milde) Hieron.	Siberian Selaginella; Siberian spikemoss
Equisetaceae (Horsetail family)	
Equisetum variegatum Schleich. ssp variegatum	Northern mottled scouring-rush; variegated horsetail
Equisetum scirpoides Michx.	Dwarf scouring-rush; sedge-like horsetail
Equisetum fluviatile L. ampl. Ehrh.	Swamp horsetail; water horsetail; pipes
Equisetum arvense L.	Common or field horsetail
Pinaceae (Pine family)	
Picea glauca (Moench) Voss	White spruce
Gramineae (Grass family)	
Hierochloë alpina (Sw.) Roem. & Schult.	Alpine holy-grass; alpine seneca grass
Arctagrostis latifolia (R. Br.) Griseb.	Arctagrostis
Calamagrostis canadensis (Michx.) Beauv.	Bluejoint
Poa arctica R. Br. ssp arctica	Arctic blue-grass; arctic meadow-grass
Agropyron macrourum (Turcz.) Drobov	Jacutian wheat-grass
Elymus arenarius L. ssp mollis (Trin.) Hult. var villosissimus (Scribn). Hult.	Lyme-grass; dune-grass
Cyperaceae (Sedge family)	
Eriophorum angustifolium Honck. ssp subarcticum (Vassiljev) Hult.	Common, tall, or narrow-leaved cottongrass
Eriophorum Scheuchzeri Hoppe var Scheuchzeri	Scheuchzer's or arctic cottongrass
Eriophorum russeolum E. Fries var albidum Nyl.	Russet cottongrass
Eriophorum vaginatum L. ssp spissum (Fern.) Hult.	Hare's tail; sheathed cottongrass
Carex chordorrhiza Ehrh.	Creeping or cordroot sedge
Carex Lachenalii Schkuhr	Arctic hare's-foot sedge
Carex aquatilis Wahlenb. ssp. aquatilis	Water or aquatic sedge
Carex podocarpa C.B. Clarke	Short-stalked or podocarp sedge
Carex microchaeta Holm	
Carex rariflora (Wahlenb.) J.E. Sm.	Loose-flowered, alpine sedge
Carex misandra R. Br.	Short-leaved sedge
Carex saxatilis L. ssp laxa (Trautv.) Kalela	
Juncaceae (Rush family)	
Luzula parviflora (Ehrh.) Desv.	Small-flowered wood-rush
Luzula arctica Blytt	Snow or arctic wood-rush
Salicaceae (Willow family)	
Populus balsamifera L. ssp balsamifera	Balsam poplar; cottonwood
Salix reticulata L. ssp reticulata	Netted willow
Salix polaris Wahlenb. ssp pseudopolaris (Flod.) Hult.	Polar willow
Salix phlebophylla Anderss.	Veiny-leafed willow
Salix arctica Pall. ssp arctica	Arctic willow
Salix glauca L. ssp acutifolia (Hook.) Hult.	Northern willow
Salix Chamissonis Anderss.	Chamisso's willow
Salix Barrattiana Hook.	

Salix alaxensis (Anderss.) Cov. ssp alaxensis	Alaska willow; feltleaf willow
Salix pulchra Cham.	Beautiful or diamond-leaf willow
Betulaceae (Birch family)	
Betula nana L. ssp exilis (Sukatsch.) Hult.	Dwarf birch
Betula glandulosa Michx.	Shrub birch; dwarf birch; glandular birch
Betula papyrifera Marsh. ssp humilis (Regel) Hult.	White or paper birch
Alnus crispa (Ait.) Pursch ssp crispa	Mountain alder
Polygonaceae (Buckwheat family)	
Rumex arcticus Trautv.	Arctic dock
Oxyria digyna (L.) Hill	Mountain sorrel
Polygonum viviparum (L.)	Viviparous knotweed; alpine bistort
Polygonum bistorta L. ssp plumosum (Small) Hult.	Snake-weed; mountain meadow bistort
Polygonum alaskanum (Small) Wight	Wild rhubarb; alpine fleeceflower
Caryophyllaceae (Pink family)	
Stellaria Edwardsii R. Br.	Long-stalked stitchwort
Cerastium maximum L.	Great chickweed
Cerastium Beeringianum Cham. & Schlecht. var Beeringianum	Beringian chickweed
Wilhelmsia physodes (Fisch.) McNeill	
Silene acaulis L. ssp acaulis	Moss campion
Melandrium apetalum (L.) Fenzl ssp arcticum (E. Fries) Hult.	
Ranunculaceae (Crowfoot family)	
Caltha palustris L. ssp arctica (R. Br.) Hult.	Marsh marigold
Delphinium glaucum S. Wats.	Glaucus larkspur
Aconitum delphinifolium DC. ssp delphinifolium	Delphinium-leaved monkshood
Anemone Richardsonii Hook.	Richardson's anemone
Pulsatilla patens (L.) Mill. spp multifida (Pritz.) Zamels	Pasqueflower; spreading pasqueflower
Ranunculus Gmelini DC. ssp Gmelini	Gmelin's buttercup
Ranunculus hyperboreus Rottb. ssp hyperboreus	
Ranunculus Pallasii Schlecht.	Pallas's buttercup
Ranunculus lapponicus L.	Lapland buttercup
Ranunculus nivalis L.	Snow buttercup
Ranunculus pygmaeus Wahlenb. ssp pygamaeus	Dwarf buttercup; pigmy buttercup
Papaveraceae (Poppy family)	
Papaver Macounii Greene	Macoun's poppy
Cruciferae (Mustard family)	
Cardamine pratensis L. spp angustifolia (Hook.) O.E. Schulz	Cuckooflower; lady's smock; meadow bittercress
Cardamine hyperborea O.E. Schulz.	Fingered bittercress
Descurainia sophioides (Fisch.) O.E. Shulz.	Northern tansy-mustard
Erysimum Pallasii (Pursh) Fern.	Pallas's wallflower
Erysimum cheiranthoides L. ssp altum Ahti	Common treacle-mustard
Erysimum inconspicuum (S. Wats.) MacM.	Small-flowered prairie-rocket
Crassulaceae (Stonecrop family)	
Sedum rosea (L.) Scop. ssp integrifolium (Raf.) Hult.	Roseroot
Saxifragaceae (Saxifrage family)	
Saxifraga oppositifolia L. ssp oppositifolia	Purple mountain saxifrage
Saxifraga hirculus L.	Bog saxifrage

Saxifraga flagellaris Willd. ssp setigera (Pursh) Tolm.	Flagellate saxifrage or spiderplant
Saxifraga tricuspidata Rottb.	Three-toothed or prickly saxifrage
Saxifraga punctata L. ssp Nelsoniana (D. Don) Hult.	Brook or cordate-leaved saxifrage
Saxifraga cernua L.	Nodding, bulblet, or bulbous saxifrage
Saxifraga rivularis L. var rivularis	Alpine brook saxifrage
Saxifraga davurica Willd. ssp grandipetala (Engler & Irmsch.) Hult.	Dahurian saxifrage
Chrysoplenium tetrandrum (Lund) T. Fries	Northern water carpet
Parnassia Kotzebuei Cham. & Schlecht.	Kotzebue's grass-of-parnassus
Ribes triste Pall.	American wild red-currant; swamp red-currant; northern red-currant
Rosaceae (Rose family)	
Spiraea Beauverdiana Schneid.	Beauverd's or Alaska spiraea
Rubus chamaemorus L.	Cloudberry; baked apple
Potentilla palustris (L.) Scop.	Marsh or purple cinquefoil
Potentilla fruticosa L.	Shrubby cinquefoil; yellow tundra-rose; golden hardhack
Potentilla uniflora Ledeb.	One-flowered cinquefoil
Geum glaciale Adams	Glacier avens
Dryas octopetala L. ssp octopetala	Mountain avens
Dryas integrifolia M. Vahl ssp integrifolia	Entire-leafed mountain avens; white dryas
Rosa acicularis Lindl.	Prickly rose
Leguminosae (Pea family)	
Lupinus arcticus S. Wats.	Arctic lupine
Astragalus alpinus L. ssp alpinus	Alpine milk-vetch
Oxytropis Maydelliana Trautv.	Maydell's oxytrope
Hedysarum alpinum L. ssp americanum (Michx.) Fedtsch.	Alpine hedysarum
Lathyrus maritimus L. ssp pubescens (Hartm.) C. Regel	Beach pea
Violaceae (Violet family)	
Viola epipsila Ledeb. ssp repens (Turcz.) Becker	Two-leaved marsh violet or northern marsh violet
Elaeagnaceae (Oleaster family)	
Shepherdia canadensis (L.) Nutt.	Soapberry; buffalo berry
Onagraceae (Evening primrose family)	
Epilobium angustifolium L. ssp angustifolium	Fireweed; great willow-herb; etc.
Epilobium latifolium L.	Arctic fireweed; river beauty
Epilobium palustre L.	Swamp willow-herb
Haloragaceae (Water milfoil family)	
Hippuris vulgaris L.	Common mare's tail
Umbelliferae (Parsley family)	
Bupleurum triradiatum Adams ssp arcticum (Regel) Hult.	Hare's ear; thoroughwax
Pyrolaceae (Wintergreen family)	
Pyrola asarifolia Michx. var purpurea (Bunge) Fern.	Pink pyrola; liver-leaf; wintergreen
Empetraceae (Crowberry family)	
Empetrum nigrum L. spp hermaphroditum (Lange) Böcher	Common or black crowberry

Ericaceae (Heath family)	
Ledum palustre L. ssp *decumbens* (Ait.) Hult.	Narrow-leafed Labrador tea
Ledum palustre L. ssp *groenlandicum* (Oeder) Hult.	Labrador tea
Rhododendron lapponicum (L.) Wahlenb.	Lapland rosebay
Loiseleuria procumbens (L.) Desv.	Alpine or trailing azalea
Cassiope tetragona (L.) D. Don ssp *tetragona*	Arctic heather; lapland cassiope
Andromeda polifolia L.	Marsh Andromeda; common bog-rosemary
Arctostaphylos alpina (L.) Spreng.	Alpine bearberry
Arctostaphylos rubra (Rehd. & Wilson) Fern.	Bearberry
Vaccinium vitis-idaea L. ssp *minus* (Lodd.) Hult.	Bog cranberry; lingonberry
Vaccinium uliginosum L. ssp *alpinum* (Bigel.) Hult.	Alpine blueberry; alpine bog-bilberry
Oxycoccus microcarpus Turcz.	Small-fruited cranberry
Primulaceae (Primrose family)	
Douglasia ochotensis (Willd.) Hult.	
Dodecatheon frigidum Cham. & Schlecht.	Frigid shooting-star
Polemoniaceae (Polemonium family)	
Polemonium acutiflorum Willd.	Acutish Jacob's ladder
Boraginaceae (Borage family)	
Myosotis alpestris F.W. Schmidt ssp *asiatica* Vestergr.	Alpine forget-me-not
Mertensia paniculata (Ait.) G. Don var *paniculata*	Bluebell; tall lungwort
Scrophulariaceae (Figwort family)	
Castilleja caudata (Pennell) Rebr.	
Castilleja elegans Malte	Indian paint-brush
Pedicularis lapponica L.	Lapland lousewort
Pedicularis labradorica Wirsing	Labrador lousewort
Pedicularis Langsdorffii Fisch. ssp *arctica* (R. Br.) Pennell	Langsdorf's lousewort
Pedicularis sudetica Willd. ssp *interior* Hult.	Sudetan lousewort
Pedicularis sudetica Willd. ssp *albolabiata* Hult.	Sudetan lousewort
Pedicularis capitata Adams	Capitate lousewort
Pedicularis Oederi M. Vahl	Oeder's lousewort
Pedicularis Kanei Durand ssp *Kanei*	
Lentibulariaceae (Bladderwort family)	
Pinguicula villosa L.	Hairy butterwort
Utricularia vulgaris L. ssp *macrorhiza* (Le conte) Clausen	Bladderwort
Caprifoliaceae (Honeysuckle family)	
Linnaea borealis L. ssp *americana* (Forbes) Hult.	American twinflower
Valerianaceae (Valerian family)	
Valeriana capitata Pall.	Capitate Valerian
Compositae (Composite family)	
Aster sibiricus L.	Siberian or Richardson's aster
Erigeron purpuratus Greene	
Antennaria Friesiana (Trautv.) Ekman	
Achillea borealis Bong.	Common yarrow; milfoil
Matricaria ambigua (Ledeb.) Ktylof.	Scentless mayweed or corn feverfew

(Tripleurospermum phaeocephalum (Rupr.) Pobed.)	
Artemisia arctica Less. ssp arctica	Arctic wormwood
Petasites frigidus (L.) Franch.	Lapland butterbur
Petasites hyperboreus Rydb.	
Arnica alpina (L.) Olin ssp angustifolia (M. Vahl) Maguire	Alpine Arnica
Senecio congestus (R. Br.) DC.	Marsh fleawort; marsh fleabane
Senecio yukonensis Pors.	Alaska-Yukon Senecio
Senecio fuscatus (Jord. & Fourr.) Hayek	Orange Senecio
Senecio atropurpureus (Ledeb.) Fedtsch. ssp frigidus (Richards.) Hult.	Arctic Senecio
Senecio residifolius Less.	
Senecio lugens Richards.	Black-tipped groundsel
Saussurea angustifolia (Willd.) DC.	Narrow-leafed Saussurea
Taraxacum ceratophorum (Ledeb.) DC.	Horned dandelion

B) Bryophytes

Mosses -- genera arranged in phylogenetic order according to Worley and Iwatsuki (1970) and species within genera arranged alphabetically; authorities also according to Worley and Iwatsuki, 1970.

Sphagnum balticum (Russow) C. Jens.
Sphagnum fimbriatum Wils. ex J. Hook.
Sphagnum fuscum (Schimp.) Klinggr.
Sphagnum lenense H. Lindb.
Sphagnum rubellum Wils.
Sphagnum squarrosa Crome.

Polytrichum juniperinum Hedw.

Dicranum elongatum Schwaegr.
Dicranum fuscescens Turn.
Dicranum scoparium Hedw.

Rhacomitrium lanuginosum (Hedw.) Brid.

Bryum sp Hedw.

Mnium sp Hedw.

Aulacomnium palustre (Hedw.) Schwaegr.
Aulacomnium turgidum (Wahlenb.) Schwaegr.

Drepanocladus sp C. Mull

Hylocomium sp B.S.G.

Pleurozium Schreberi (Brid.) Mitt.

Liverworts -- in phylogenetic order according to and authorities from Worley, 1970.

Ptilidium ciliare (Web.) Hampe
Lophozia sp
Marchantia polymorpha L.

C) Lichens -- in alphabetical order; most authorities are from Hale, 1979.

Alectoria ochroleuca (Hoffm.) Mass.
Cetraria andrejevii (Llana) W. Culb. & C. Culb.
Cetraria cucullata (Bell.) Ach.
Cetraria delisei (Bory) Th. Fr.

Cetraria islandica (L.) Ach.
Cetraria nivalis (L.) Ach.
Cetraria pinastri (Scop.) S. Gray
Cetraria richardsonii Hook.
Cetraria sepincola (Ehrh.) Ach.
Cetraria tilesii Ach.
Cladina arbuscula (Wallr.) Rabenh.
Cladina mitis (Sandst.) Hale & Culb.
Cladina rangiferina (L.) Wigg.
Cladina stellaris (Opiz.) Brodo
Cladonia bellidiflora (Ach.) Schaer.
Cladonia chlorophaea (Flk.) Spreng.
Cladonia crispata (Ach.) Flot.
Cladonia cristatella Tuck.
Cladonia deformis (L.) Hoffm.
Cladonia fimbriata (L.) Fr.
Cladonia gonecha (Ach.) Asah.
Cladonia gracilis (L.) Willd.
Cladonia pleurota (Flk.) Schaer.
Cladonia pyxidata (L.) Hoffm.
Cladonia squamosa (Scop.) Hoffm.
Cladonia subsquamosa (Nyl.) Vain.
Cladonia uncialis (L.) Wigg.
Cornicularia divergens Ach.
Dactylina arctica (Hook.) Nyl.
Hypogymnia physodes (L.) Nyl.
Lobaria linita (Ach.) Rabh.
Nephroma arcticum (L.) Torss.
Nephroma expallidum
Ochrolechia frigida (Sw.) Lynge
Ochrolechia upsaliensis (L.) Mass.
Parmeliopsis ambigua (Wulf.) Nyl.
Peltigera aphthosa (L.) Willd.
Peltigera canina (L.) Willd.
Pertusaria dactylina (Ach.) Nyl.
Pertusaria panyrga (Ach.) Mass.
Rhizocarpon geographicum (L.) DC.
Solorina crocea (L.) Ach.
Sphaerophorus globosus (Huds.) Vain.
Stereocaulon tomentosum Fr.
Thamnolia subuliformis (Ehrh.) Culb.
Thamnolia vermicularis (Sw.) Schaer.
Umbilicaria sp
Usnea sp
Xanthoria elegans (Link) Th. Fr.
(Caloplaca elegans (Link) Th. Fr.)

APPENDIX 2: CLIMATE OF THE NORTHERN YUKON

The climate of the northern Yukon Territory is not well-understood due to the scarcity of weather stations and their location is such that they characterize only specific and small areas. Much of the available data have been recorded at the only two long-term stations: Komakuk Beach and Shingle Point. These stations are located near the Yukon coast and are close to the mouth of the Malcolm and the Blow rivers respectively. Their weather observation program records synoptic forecasts, air temperatures, precipitation, and wind speed. Another long-term station is located at Old Crow, slightly south of the study area limits; the recorded data primarily consist of air temperature and precipitation. In Alaska, the station at Barter Island provides supportive precipitation and temperature data for the Canadian coastal stations, while the Eagle station performs a similar function for the Old Crow station. As all these stations are located on or near the periphery of the study, climatic data pertaining to the bulk of this area are missing. Consequently, knowledge of the climate is very interpretative or, in a few cases, has been extrapolated from short-term monitoring efforts. Much of the material provided in this appendix has been extracted from personal communications received from H. Wahl of the Yukon Weather Office in Whitehorse and B. Findlay of the Atmospheric Environment Service in Downsview, Ontario.

GENERAL CLIMATE

Approximately four-fifths of the area is in the tundra climatic zone, while the remainder is in the northern temperate climatic zone. The lower boundary of the tundra zone is generally taken to be the poleward limit of tree growth or the vicinity where the mean temperature of the warmest month attains 10°C. Since this area is associated with cold climatic regimes, the winters are exceptionally prolonged and the summers are relatively short with rapid transition. Winter is approximately eight months long and corresponds to what is commonly termed the 'polar night' period. The almost continuous darkness which occurs in this winter period is due to the tilt of the earth's axis of rotation. In contrast with this period, the summers or 'polar day' periods are intervals possessing nearly continuous daylight. Over the total area, factors such as continental and maritime air masses and the nature and form of contiguous land or water surfaces are important in determining climatic conditions. Considering the influence of these factors, general statements can be made in relation to the ecoregions depicted.

Northern Coastal Plain Ecoregion

This ecoregion coincides with the long and narrow plain which parallels the Yukon coastline. Its southern limit is associated with the 154-meter elevation contour. This area has a rather cold climate as it is strongly influenced by the Arctic Ocean and air masses; unlike the other ecoregions, this segment of the study area experiences a maritime climate.

As Tables A and B of this appendix show, the mean annual temperatures range from -10°C at Shingle Point to -12°C at Komakuk Beach. The higher annual temperature in the east is caused by the easier and more frequent advection of continental warm air from both the Mackenzie Valley and through the Blow River depression.

Winter temperatures are consistently low and extremely variable. Mean daily winter temperatures are between -10°C and -25°C. The coldest month in winter is February, which has a mean daily temperature of roughly -28°C. Mild spells are periodically incurred during the winter as a result of air masses originating over the eastern Beaufort Sea -- the warmer temperatures that accompany these spells are largely due to mid-winter storms which have moved northwards through the Bering Strait. This results in strong southerly winds over the Northern Coastal Plain, producing near chinook conditions.

For the summer, the temperatures are also highly variable, as demonstrated by maximum and minimum temperatures recorded at both weather stations. For Shingle Point, the mean daily temperature for July, the warmest month, is near 11°C; for Komakuk Beach, however, it is closer to 7°C. The slightly warmer temperatures in the east section in the summer as well as the winter are generated by the easier and more frequent advection of continental warm air from both the Mackenzie Valley and through the Blow River gap. During the summer cold spells, heavy frost can result. This reduction in air temperature is a product of both onshore winds and the proximity of ice pack and cool coastal waters.

Precipitation through the year is generally light, averaging 127 to 188 mm per year. Summer rains account for 60% of the total precipitation. This is chiefly influenced by continental and maritime air circulation.

Elev.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
600 m	-24	-23	-17	-7	3	12	14	12	4	-4	-15	-21	-5.5
1,200 m	-20	-17	-15	-9	-1	7	9	8	1	-5	-13	-16	-5.9

These warm and moist air masses tend to penetrate the Northern Coastal Plain via the Mackenzie and Blow river valleys. As a consequence, rainfall is higher in the eastern section.

The orographic barrier of the Northern Mountains Ecoregion influences the direction of surface winds. By frequency and magnitude (Table C), the dominant winds blow easterly and, to a lesser extent, westerly. During the period of April to September, there is a greater frequency of strong (greater than 20 km/h) westerly winds but a greater frequency of light (less than 20 km/h) easterly winds. On a yearly average, this relationship holds as well. Certain portions of the Northern Coastal Plain possess winds which are primarily southerly. The upper reaches of the Blow River valley and, to some degree, the Babbage River valley, are representative. The incidence of these winds is most pronounced during the fall and winter.

Northern Mountains Ecoregion

Climate varies greatly in this ecoregion due largely to the terrain and its associated complexities of slope, aspect, and elevation. Since there are no long-term weather stations in this area, the description of the climate is highly interpretative. The overall climate of this mountainous area is considered to be milder in most respects than that of the Northern Coastal Plain. Winters remain long and fairly cold, but summers are warm and occasionally hot.

The temperature regime is variable and closely tied with slope aspect and the elevation and configuration of the terrain. For the months of May through September, the daily average temperature gradient (lapse rate) is about 0.7°C per 100 m below an elevation of 1,500 m. This, however, during December through February, can be dramatically reversed in a phenomenon known as Arctic Inversion. Cold Arctic outbreaks are generally confined to levels below 1,000 to 3,000 m. This coldness in the lower elevations is augmented by strong radiational cooling during the long Arctic nights. Radiative cold air developing on mountain slopes will, because of its density, drain into the valley floors further enhancing the reverse lapse rate. When storms advect warm air into the area, however, although cold air is not eroded from the valley floors the mountain slopes above 600 to 1,500 m will be moderated.

Under extreme conditions, temperature increases of 3°C to 5°C per 100 m can occur in the lower 600 to 1,500 m. On the average, however, the lapse rate during January is +0.8°C per 100 m below an elevation of 1,500 m; above this, a lapse rate of -0.3°C per 100 m occurs to 3,000 m elevation.

The accompanying calculated mean daily temperatures per elevation are from H. Wahl in Whitehorse.

Precipitation occurs primarily as snow, which is received from October through to April; rainfall is associated more with summer showers. Records are not available to indicate the actual amount of precipitation received. As with the temperature regime, the precipitation pattern would vary from one locale to another with increasing elevation. A precipitation lapse rate of +20-30 mm per 100 m is thought to be appropriate.

Old Crow Basin Ecoregion

The climate of this ecoregion can be classed as relatively arid, having warm summers and prolonged, severe winters. The encircling mountains form a natural barrier to the passage of most weather fronts. In the west, the Old Crow and Keele ranges inhibit intrusion of moist air, although some penetration is afforded by the valley of the Porcupine River and, to a lesser extent, the upper reaches of the Colleen River. In summer, the Northern Mountains provide protection from the weak low pressure systems moving landward from the Beaufort Sea. In the winter, these cold air masses are fairly strong and are able to break the mountain barrier and reach the basin. Also in winter, storms in the Gulf of Alaska occasionally move northwards into the Bering Strait and Beaufort Sea, causing an influx from the northeast of warm air into the basin.

The data collected at the Old Crow weather station are thought to be closely representative of the basin. The records for the Old Crow station are noted in Table D. However, the data from Eagle, Alaska, suggest that precipitation figures should be increased 5%-10% for the eastern portion of the Old Crow Basin. As such, this ecoregion has, on a yearly basis, greater rainfall and snowfall than does the Northern Coastal Plain Ecoregion. In terms of temperature, the mean daily figures

are also higher and mean values above 0°C extend over a longer period of the year.

Surface winds are estimated to have a strong northwesterly and southeasterly flow. The majority of these winds is less than 20 km/h. Winds exceeding this speed usually have a westerly component and are associated with storms moving through the Beaufort Sea.

North Ogilvie Mountains Ecoregion

Much of the climate for this ecoregion is similar to the Northern Mountains.

Table A: Climatological data from Atmospheric Environment's (Environment Canada) Shingle Point Station

SHINGLE POINT, YUKON: 68°57'N, 137°13'W; Elevation 53 m

1957-73 calc.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEARLY AVERAGE
TEMPERATURE (°C)													
Daily Mean	-26.7	-27.7	-23.8	-16.9	-4.0	5.1	10.7	7.9	1.3	-8.3	-19.1	-22.9	-10.4
Mean Max.	-22.7	-23.0	-21.3	-12.4	-0.8	9.3	15.4	11.9	4.4	-5.4	-16.2	-16.8	-6.6
Mean Min.	-31.1	-32.3	-29.7	-21.3	-7.7	0.9	5.8	3.6	-1.7	-11.4	-23.3	-27.5	-14.6
Extreme Max.	1.7	0.6	5.0	8.9	20.0	28.3	27.8	28.9	18.3	15.0	7.8	1.7	
Date/Year	19/62	28/68	9/65	28/67	30/68	26/60	16/66	16/57	1/57	7/69	1/70	10/60	
Extreme Min.	-51.1	-52.2	-43.3	-38.9	-30.6	-8.9	-6.7	-5.6	-13.3	-30.0	-42.8	-47.2	
Date/Year	27/60	19/72	19/73	8/61	16/65	22/57	27/57	9/67	29/59	27/70	22/69	25/57	
PRECIPITATION (Snowfall in cm; rainfall and total precipitation in mm)													
Mean Rainfall	NIL	NIL	NIL	NIL	2.8	18.0	36.1	38.1	15.2	1.3	NIL	NIL	111.5
Mean Snowfall	4.3	4.8	5.8	8.6	6.9	1.0	NIL	3.1	7.9	22.4	7.4	3.8	76.0
Mean Ttl Pcpn	4.3	4.8	5.8	8.6	9.7	19.0	36.1	41.2	23.1	23.7	7.4	3.8	187.5

Table B: Climatological data from Atmospheric Environment's (Environment Canada) Komakuk Beach Station

KOMAKUK BEACH, YUKON: 69°35'N, 140°11'W; Elevation 9 m

1957-73 calc.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEARLY AVERAGE
TEMPERATURE (°C)													
Mean Daily	-26.4	-27.9	-26.1	-18.1	-5.4	2.7	7.3	5.4	0.3	-9.1	-8.8	-22.7	-11.6
Mean Max.	-21.8	-23.6	-22.1	-13.7	-2.1	5.4	11.7	9.0	3.2	-5.8	-14.8	-18.3	-7.7
Mean Min.	-31.1	-32.2	-30.2	-22.5	-8.7	-0.1	2.8	1.8	-2.7	12.3	22.7	-27.1	-15.4
Extreme Max.	8.3	-0.6	2.8	7.8	17.2	25.6	27.2	25.6	23.3	13.3	8.3	7.2	
Date/Year	23/61	25/62	15/67	9/59	30/71	7/61	14/60	8/68	14/65	7/69	29/66	10/60	
Extreme Min.	-46.7	-47.8	-47.8	-36.7	-25.0	-9.4	-5.6	-7.8	-17.8	-29.4	-38.9	-44.4	
Date/Year	28/60	5/68	11/59	1/71	1/64	2/66	11/63	31/67	23/70	17/70	26/63	24/61	
PRECIPITATION (snowfall in cm; rainfall and total precipitation in mm)													
Mean Rainfall	0.3	NIL	NIL	NIL	0.8	10.4	27.4	28.7	6.9	0.5	0.5	NIL	75.5
Mean Snowfall	4.6	2.3	2.5	2.3	3.3	1.8	TR	4.6	6.9	14.2	4.6	4.1	51.2
Mean Ttl Pcpn	4.9	2.3	2.5	2.3	4.1	12.2	27.4	33.3	13.8	14.7	5.1	4.1	126.7

Table C: Surface wind speeds and directional frequencies for Atmospheric Environment's (Environment Canada) Komakuk Beach Station

Wind*	Jan. to March		April to June		July to Sept.		Oct. to Dec.		Yearly	
Direction	<20km/h	>20km/h	<20km/h	>20km/h	<20km/h	>20km/h	<20km/h	>20km/h	<20km/h	>20km/h
N	1	-	4	-	11	1	8	-	24	1
NNE	3	-	7	-	16	-	7	2	33	2
NE	6	8	28	6	32	3	12	17	78	34
ENE	8	8	20	3	20	1	13	2	61	14
E	78	143	114	128	118	70	64	99	374	440
ESE	34	35+	19	17	34	11	30	30	117	93
SE	11	6	12	-	11	1	12	4	46	11
SSE	2	-	2	-	6	-	6	-	16	-
S	2	-	11	2	26	1	25	11	64	14
SSW	8	-	11	3	18	1	14	4	51	8
SW	21	2	23	7	41	9	37	29	122	37
WSW	51	18	43	16	71	10	76	35	241	79
W	137	154	148	92	143	49	125	108	553	403
WNW	8	14	21	8	25	7	7	10	61	39
NW	4	4	15	-	13	2	8	2	40	8
NNW	3	-	3	-	11	1	7	-	24	1

*Indicates the direction from which the wind is coming, measured at 12:00 hours Greenwich mean time (observations for the years 1961-1963 and 1965-1971).

Table D: Climatological data from Atmospheric Environment's (Environment Canada) Old Crow Station

OLD CROW, YUKON: 67°34'N, 139°50'W; Elevation 98 m

1957-73 calc.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEARLY AVERAGE
TEMPERATURE (°C)													
Mean Daily	-34.4	-29.6	-23.7	-11.6	0.6	12.5	13.9	9.9	2.6	-8.1	-24.1	-29.6	-10.1
Mean Max.	-29.7	-24.6	-18.0	-5.6	6.0	18.7	20.3	15.3	7.4	-4.0	-19.9	-24.4	-4.9
Mean Min.	-39.3	-34.5	-29.3	-17.5	4.8	6.3	7.4	4.4	-2.1	-12.2	-28.2	-33.9	-15.3
Extreme Max.	-1.1	-0.6	6.7	9.4	23.9	30.6	30.0	29.4	20.6	12.8	6.1	-3.3	
Date/Year	1/70	25/70	21/54	21/53	31/53	16/69	23/55	9/54	17/73	7/69	1/70	23/70	
Extreme Min.	-55.6	-54.4	-47.8	-39.4	-17.8	-8.3	-1.7	-5.0	-37.2	-46.7	-56.7	-56.7	
Date/Year	21/69	21/55	2/56	1/71	24/56	1/60	20/54	11/69	24/70	31/53	17/69	12/75	
PRECIPITATION (snowfall in cm; rainfall and total precipitation in mm)													
Mean Rainfall	NIL	NIL	NIL	NIL	2.5	31.0	25.2	39.4	8.9	1.8	NIL	NIL	108.7
Mean Snowfall	8.6	10.2	3.6	6.6	4.3	TR	TR	1.0	11.4	21.1	16.8	13.2	96.8
Mean Ttl pcpn	8.6	10.2	3.6	6.6	6.8	31.0	25.2	40.4	20.3	22.9	16.8	13.2	205.5

APPENDIX 3: MAMMALS RECORDED FOR THE NORTHERN YUKON

Data from Banfield (1974) and nomenclature from Knox Jones *et al*. (1975).

Species	Common Name
Order Insectivora	
Family Soricidae	
Sorex cinereus	Masked or common shrew
Sorex obscurus	Dusky shrew
Sorex arcticus	Arctic shrew
Order Lagomorpha	
Family Ochotonidae	
Ochonata princeps	Pika
Family Leporidae	
Lepus americanus	Snowshoe hare
Order Rodentia	
Family Sciuridae	
Spermophilus parryii	Arctic ground squirrel
Tamiasciurus hudsonicus	Red squirrel
Family Castoridae	
Castor canadensis	Beaver
Family Cricetidae	
Clethrionomys rutilis	Northern red-backed vole
Dicrostonyx torquatus	Collared lemming
Lemmus sibiricus	Brown lemming
Microtus gregalis	Singing vole
Microtus oeconomus	Meadow vole
Microtus xanthognathus	Chestnut-cheeked vole
Synaptomys borealis	Northern bog lemming
Family Erethizontidae	
Erethizon dorsatum	Porcupine
Order Carnivora	
Family Canidae	
Canis latrans	Coyote
Canis lupus	Wolf
Alopex lagopus	Arctic fox
Vulpes vulpes	Red fox
Family Ursidae	
Ursus americanus	Black bear
Ursus arctos	Grizzly bear
Ursus maritimus	Polar bear
Family Mustelidae	
Martes americana	Marten
Mustela erminea	Ermine or Short-tailed weasel
Mustela nivalis	Least weasel
Mustela vison	Mink
Gulo gulo	Wolverine
Lutra canadensis	River otter

Family Felidae	
Lynx lynx	Lynx
Order Pinnipedia	
Family Phocidae	
Phoca vitulina	Harbour seal
Phoca hispida	Ringed seal
Erignathus barbatus	Bearded seal
Order Artiodactyla	
Family Cervidae	
Alces alces	Moose
Rangifer tarandus	Caribou
Family Bovidae	
Ovis dalli	Dall sheep

APPENDIX 4: BIRD SPECIES WHOSE BREEDING RANGES INCLUDE ALL OR PART OF THE NORTHERN YUKON

Data and nomenclature mainly from Godfrey (1966).

Species	Common Name
Order Gaviiformes	
Family Gaviidae	
Gavia adamsii	Yellow-billed loon
Gavia arctica	Arctic loon
Gavia stellata	Red-throated loon
Order Podicipediformes	
Family Podicipedidae	
Podiceps grisegena	Red-necked grebe
Podiceps auritus	Horned grebe
Order Anseriformes	
Family Anatidae	
Olor columbianus	Whistling swan
Branta bernicla	Brant
Branta canadensis	Canada goose
Anser albifrons	White-fronted goose
Anas platyrhynchos	Mallard
Anas acuta	Pintail
Anas carolinensis	Green-winged teal
Anas americana	American widgeon
Anas clypeata	Shoveler
Aythya valisineria	Canvasback
Aythya marila	Greater scaup
Aythya affinis	Lesser scaup
Clangula hyemalis	Oldsquaw
Histrionicus histrionicus	Harlequin duck
Somateria mollissima	Common eider
Somateria spectabilis	King eider
Melanitta deglandi	White-winged scoter
Melanitta perspicillata	Surf scoter
Mergus serrator	Red-breasted merganser
Family Accipteridae	
Accipter gentilis	Goshawk
Buteo lagopus	Rough-legged hawk
Aquila chrysaëtos	Golden eagle
Haliaeetus leucocephalus	Bald eagle
Family Pandionidae	
Pandion haliaetus	Osprey
Family Falconidae	
Falco rusticolus	Gyrfalcon
Falco peregrinus	Peregrine falcon
Falco columbarius	Pigeon hawk; Merlin
Order Galliformes	
Family Tetraonidae	
Canachites canadensis	Spruce grouse
Bonasa umbellus	Ruffed grouse

Lagopus lagopus	Willow ptarmigan
Lagopus mutus	Rock ptarmigan
Order Charadriiformes	
Family Charadriidea	
Charadrius semipalmatus	Semipalmated plover
Pluvialis dominica	American golden plover
Family Scolopacidae	
Capella gallinago	Common snipe
Numenius phaeopus	Whimbrel
Actitis macularia	Spotted sandpiper
Tringa solitaria	Solitary sandpiper
Totanus flavipes	Lesser yellowlegs
Calidris bairdii	Baird's sandpiper
Calidris minutilla	Least sandpiper
Calidris alpina	Dunlin
Calidris pusilla	Semipalmated sandpiper
Family Phalaropididae	
Lobipes lobatus	Northern phalarope
Family Stercorariidae	
Stercorarius parasiticus	Parasitic jaeger
Stercorarius longicaudus	Longtailed jaeger
Family Laridae	
Larus hyperboreus	Glaucous gull
Sterna paradisaea	Arctic tern
Order Strigiformes	
Family Strigidae	
Nyctea scandiaca	Snowy owl
Surnia ulula	Hawk owl
Strix nebulosa	Great grey owl
Asio flammeus	Short-eared owl
Aegolius funereus	Boreal owl
Order Piciformes	
Family Picidae	
Colaptes auratus	Yellow-shafted flicker
Picoïdes tridactylus	Northern three-toed woodpecker
Order Passeriformes	
Family Tyrannidae	
Sayornis saya	Say's phoebe
Empidonax alnorum	Alder flycatcher; Traill's flycatcher
Family Alaudidae	
Eremophila alpestris	Horned lark
Family Hirundinidae	
Iridoprocne bicolor	Tree swallow
Riparia riparia	Bank swallow
Petrochelidon pyrrhonota	Cliff swallow
Family Corvidae	
Perisoreus canadensis	Gray jay; Canada jay
Corvus corax	Raven
Family Paridae	
Parus hudsonicus	Boreal chickadee
Parus cinctus	Gray-headed chickadee

Family Turdidae	
Turdus migratorius	American robin
Ixoreus naevius	Varied thrush
Catherus ustulatus	Swainson's thrush
Catherus minimus	Gray-cheeked thrush
Oenanthe oenanthe	Wheatear
Family Silviidae	
Regulus calendula	Ruby-crowned kinglet
Family Motacillidae	
Motacilla flava	Yellow wagtail
Anthus spinoletta	Water pipit
Family Bombycillidae	
Bombycilla garrulus	Bohemian waxwing
Family Parulidae	
Vermivora celata	Orange-crowned warbler
Dendroica petechia	Yellow warbler
Dendroica coronata	Yellow-rumped warbler; Myrtle warbler
Dendroica striata	Blackpoll warbler
Seiurus noveboracensis	Northern waterthrush
Wilsonia pusilla	Wilson's warbler
Family Icteridae	
Euphagus carolinus	Rusty blackbird
Family Fringillidae	
Pinicola enucleator	Pine grosbeak
Carduelis hornemanni	Hoary redpoll
Carduelis flammea	Common redpoll
Loxia leucoptera	White-winged crossbill
Passerculus sandwichensis	Savannah sparrow
Junco hyemalis	Northern junco; Slate-colored junco
Spizella arborea	Tree sparrow
Zonotrichia leucophrys	White-crowned sparrow
Passerella iliaca	Fox sparrow
Calcarius lapponicus	Lapland longspur
Calcarius pictus	Smith's longspur
Plectrophenax nivalis	Snow bunting

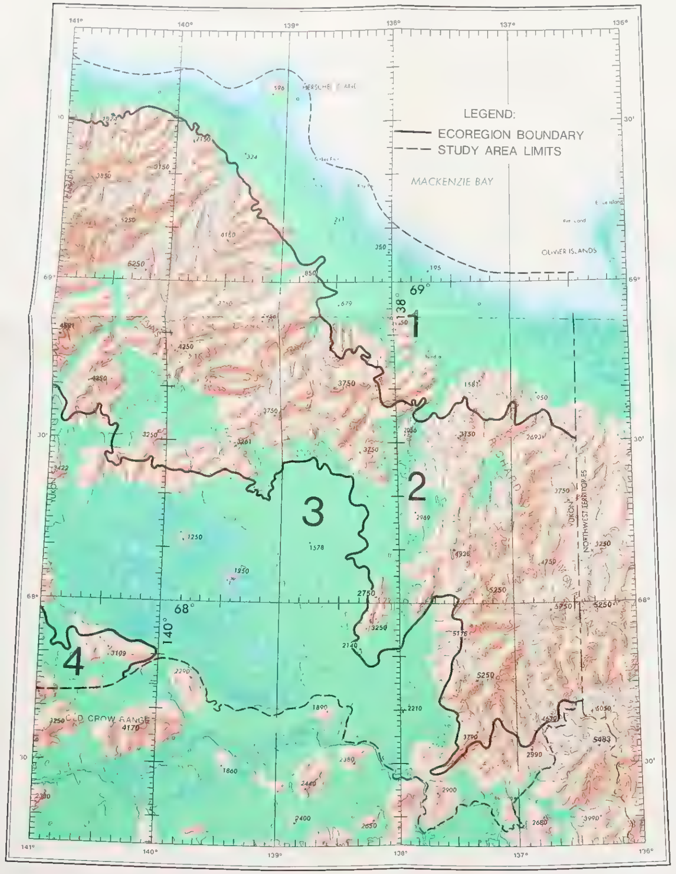
APPENDIX 5: FRESHWATER FISH RECORDED FOR THE NORTHERN YUKON

From Steigenberger et al. (1974) and McPhail and Lindsay (1970).
Nomenclature from McPhail and Lindsay (1970) and Nelson (1976).

Species	Common Name
Order Salmoniformes	
Family Esocidae	
Esox lucius	Northern pike
Family Salmonidae	
Subfamily Coregoninae	
Stenodus leucichthys nelma	Inconnu
Prosopium cylindraceum	Round whitefish
Coregonus clupeaformis	Humpback whitefish
Coregonus nasus	Broad whitefish
Coregonus sardinella	Least cisco
Coregonus autumnalis	Arctic cisco
Subfamily Thymallinae	
Thymallus arcticus	Arctic grayling
Subfamily Salmoninae	
Salvelinus namaycush	Lake trout
Salvelinus alpinus	Arctic char
Oncorhynchus kisutch	Coho salmon
Oncorhynchus tshawytscha	Chinook salmon
Oncorhynchus keta	Chum salmon
Family Osmeridae	
Subfamily Hypomesinae	
Hypomesus olidus	Pond smelt
Subfamily Osmerinae	
Osmerus eperlanus	Boreal smelt
Order Cypriniformes	
Family Cyprinidae	
Platygobio gracilis	Flathead chub
Couesius plumbus	Lake chub
Rhinichthys cataractae	Longnose dace
Family Catasomidae	
Catostomus catostomus	Longnose sucker
Order Percopsiformes	
Family Percopsidae	
Percopsis omiscomaycus	Trout-perch
Order Gadiformes	
Family Gadidae	
Lota lota	Burbot; Ling cod
Order Gasterosteiformes	
Family Gasterosteidae	
Pungitius pungitius	Nine-spine stickleback
Order Scorpaeniformes	
Family Cottidae	
Cottus cognatus	Deep water sculpin; Slimy sculpin

ECOREGIONS OF THE NORTHERN YUKON

The 1:1,000,000 scale map base is a portion of the World Aeronautical Chart WAC C-9. Green color indicates flat or relatively level terrain regardless of altitude above sea level; altitude is indicated only in feet.



SCALE IN KILOMETRES

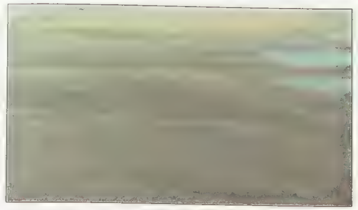
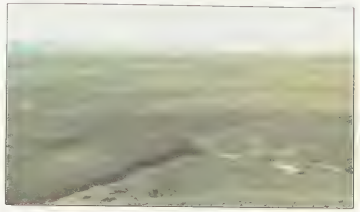
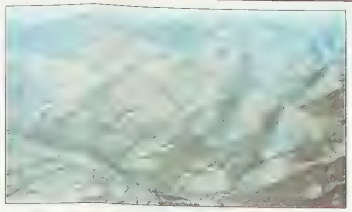
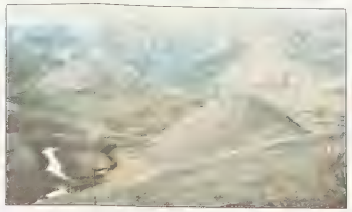
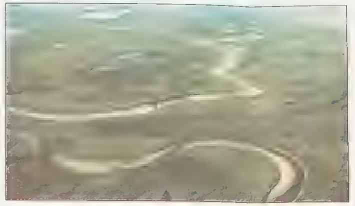
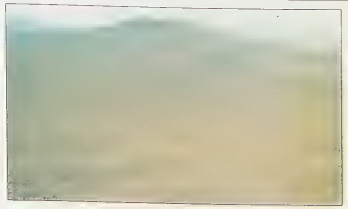
10 0 20 40 60 80 100

Environment Canada Environnement Canada

Boundaries and descriptions produced by E.B. Wiken, D.M. Welch, G.R. Ironside, and D.G. Taylor, Lands Directorate, Environmental Conservation Service, Ottawa. January 1981.

Map prepared by the Environmental Conservation Service Drafting Division.

ECOREGIONS

	1 NORTHERN COASTAL PLAIN (5,700 km²)	2 NORTHERN MOUNTAINS (17,700 km²)	3 OLD CROW BASIN (11,100 km²)	4 NORTH OGILVIE MOUNTAINS (600 km²)
REPRESENTATIVE LANDSCAPES	 	 	 	 
ECOLOGICAL OVERVIEW	The Northern Yukon lies at the interface of the Alpine, Arctic, and Subarctic ecoprovinces. These are larger and more generalized terrestrial ecosystems which are used to group several related ecoregions, and to describe a broader range of common ecological characteristics. In general, these ecoprovinces are all characterized by. low temperatures; short growing seasons; low precipitation; permafrost; patterned ground; plants such as lichens, mosses, sedges, and low-growing shrubs; low rate of biomass production and decomposition; and seasonally dormant or migratory animals.			
	This system owes much of its character to three factors: proximity to the Beaufort Sea; continuous, near-surface permafrost; and a surface form which lacks marked relief. Frequent fogs, cold sea air, and slow, near-surface runoff during the brief summer period strongly influence the development of vegetation, soils, and water bodies. Pervading wetness throughout, shallow depth of thaw, and cold ground and air temperatures are not conducive to soil weathering or plant growth. Much of this is shown by gleying of soils, patterned ground features, tussocky and trailing shrub vegetation, and beaded drainage. The sheltered lakes, numerous lagoons, and coastal beaches provide habitats for a variety of waterfowl and shorebirds	This system is markedly influenced by its high relief and complex system of slopes and ridgelines. Steep slopes, underlying permafrost, and freeze-thaw cycles promote the generation of rubbly colluvial debris, tors, and blockfields along with the establishment of alpine communities. Repeated accumulation and downslope movement of rubbly materials, especially at the higher elevations, inhibit soil development and provide an unstable medium for plant growth. Coarse materials and near-surface permafrost offer few opportunities for the retention of water in the upper watersheds; headwater streams, therefore, display rapid discharge in the spring. At lower elevations, the pediments provide a more stable medium for the tussocky and low shrub vegetation, and for soil development. The diversity of this area provides a range of habitats suitable for raptors, Dall sheep, and grizzly bears.	This system displays a warmer climatic regime since the Northern Mountains bar the cold fronts originating over the Beaufort Sea. It is capable of supporting the development of a tundra-forest transition, medium to tall shrubs, moderately deep active layers, and limited podzolization of soils. The floor of the basin is a wetland/waterscape sustained by the influent streams from the surrounding pediments and Northern Mountains, and by restricted drainage outlets. Shallow lakes and ponds provide a suitable habitat for waterfowl, muskrat, and moose. Water tables remain near or above the ground surface for prolonged periods and consequently promote the buildup of sedge and moss debris.	This system includes part of the forest-tundra transition and, at higher elevations, alpine environments. The relatively stable plant communities and the stable slopes at lower elevations suggest that frost activity is not *intense. The deeper active layer at this elevation provides a medium for the rooting of higher vegetative forms and for soil weathering. Blockfields, tors, and alpine plant communities typify the higher elevations.*
DOMINANT CHARACTERISTICS: PHYSIOGRAPHY	A plain of subdued relief that rises gently from a rapidly eroding coastline to an elevation of about 150 metres; the parent materials in the east are dominated by low, rolling moraine; in the west, however, extensive and compound fans of fluvial debris predominate; throughout, the depressional lows are occupied by organics which are often underlain by lacustrine or marine deposits.	Mountainous to hilly terrain comprised largely of folded sedimentary formations or a mantle of rubbly colluvial debris; terrain tends to be rugged and slopes are typically steep; summits reach 1100 metres; rolling hills, pediments (often in broad valleys), and side-slope tors can be locally common features.	A low-relief basin consisting mostly of organic wetlands (underlain by glacio-lacustrine sediments) and expansive and gently inclined pediments; the average elevation of the patterned and organic flats is 300 metres, while the surrounding pediments rise gently from the wetlands up to an elevation of 450 metres	Mountainous to hilly terrain comprised largely of rounded granitic formations and a rubbly mantle of colluvial detritis; slopes rise from about 300 metres elevation to summits of 910 metres; pediments, rolling hills, and some organic wetlands are common features associated with the base of the mountains.
VEGETATION	A mixture of sedge tussocks and trailing to low shrubs; vegetative cover is relatively lush and continuous; common shrubs are Labrador tea, dwarf birch, blueberry, and cranberry, whereas cottongrass is the predominant sedge; patterned wetlands consist largely of sedges and mosses.	A sparse and discontinuous cover of mountain avens, alpine bearberry, saxifrage, and crustose lichens dominates higher elevations; at lower elevations and in valley basins, a mixture of sedge tussocks and low to medium shrubs predominates, a luxuriant and continuous cover is typical of lower elevations.	A mixture of sedge tussocks and low to medium shrubs occupy the more northerly positions of the basin, but this grades, toward the south, into tall shrubs and open stands of white spruce; vegetative cover tends to be lush and continuous; sedges and mosses are typical in wetlands.	A continuous and lush cover of tussocks and low shrubs with southerly aspects favoring open stands of white spruce on both the lower and mid-slope positions; sparse and discontinuous alpine communities predominate on the upper slopes and mountain summits.
SOILS	Continuous permafrost, prolonged periods of wetness, and a shallow depth of thaw (25 cm) are typical features; mineral soils tend to be poorly weathered, acidic, fine-textured, and actively frost-churned, organic soils are poorly decomposed; massive underlying ice lenses and surface frost wedges are common.	Depth of thaw in the continuous permafrost varies from about 35 cm at lower elevations to 75 cm at higher elevations, frost promotes the active downslope movement of rubbly material on the upper slopes; frost-churned, fine-textured, imperfectly drained, slightly weathered soils have developed at lower elevations	Permafrost is continuous; active layer varies from less than about one-half metre in organics to over one metre in mineral soils; organic materials are poorly or slightly decomposed and wet for prolonged periods; mineral soils tend to be weathered and only wet for intermittent periods.	Active layer varies from one-half to one metre and permafrost is continuous, soils are actively frost-churned and grade from rubbly materials at higher elevations to fine-textured materials at lower elevations; weathering and short periods of wetness are typical.
WATER	Meandering and incised rivers are common in the moraine, whereas braided channels are more typical of fluvial deposits in the west; discharge of rivers is highly variable; wetland streams tend to be beaded; large spits and lagoons are frequent coastal features; shallow lakes are common in the swales of the moraine; near-surface, overland seepage is common.	In the west, the larger rivers such as the Malcolm and Firth are either entrenched in rocky gorges or braided over broad channels which are often occupied by aufeis; in the east, the rivers have an incised and meandering path in bedrock; streams are sinuous to irregular gravel-bed types which show high spring and low summer flows; few lakes are present.	The wetlands are largely a waterscape in which shallow lakes of variable size are ubiquitous; parts of the wetlands have been incised by meandering rivers; on the pediments, stream density is low, near-surface seepage flow is typical, and lakes are largely absent.	Large rivers and lakes are absent, several small, meandering creeks are present, but these are of low density; spring discharge is high, whereas summer flow is negligible.
CLIMATE	The climate is generally cold and arid; summer periods are brief and erratic; daily minimum exceeds 0°C in only June through to July, and mean annual temperature averages −11°C; temperature variations are extreme throughout the year; precipitation ranges from 120 mm to 190 mm; fogs and frosts are common in summer.	A cold and arid climate; mean annual temperature averages −5°C at mid-elevations and tends to decrease with higher elevations; temperatures vary considerably owing to cold air drainage and frequent inversions; precipitation varies from 150 mm to 310 mm, generally increasing with elevation and lower latitudes.	Summers are short; daily minimum exceeds 0°C from May through August; mean annual temperature averages −10°C; precipitation averages about 220 mm; rain (110 mm) falls largely in May through August.	There is little information available for this area; the trends in climatic data, however, would suggest that this area should be slightly warmer and wetter than the Northern Mountains
WILDLIFE	Coastal and inland lakes are breeding, staging, and moulting areas for large populations of waterfowl and shorebirds; major rivers are used by Arctic char and grayling for spawning and overwintering; western portion is a favoured calving area and summer range for caribou; Arctic fox are common in the moraine-dominated areas.	Frequently used by caribou for calving and for summer and early-winter range; local populations of Dall sheep occur; nesting sites for raptors and denning areas for grizzlies are common; some moose exploit the area.	A major breeding, moulting, and staging area for waterfowl and shorebirds; moose and muskrat are common throughout the wetlands, while beaver tend to be restricted to the southeastern portion of this organic terrain; pediments are used for caribou range; black bears are associated with the open spruce stands	Part of caribou winter range as well as spring migration and staging areas.

ECOREGI

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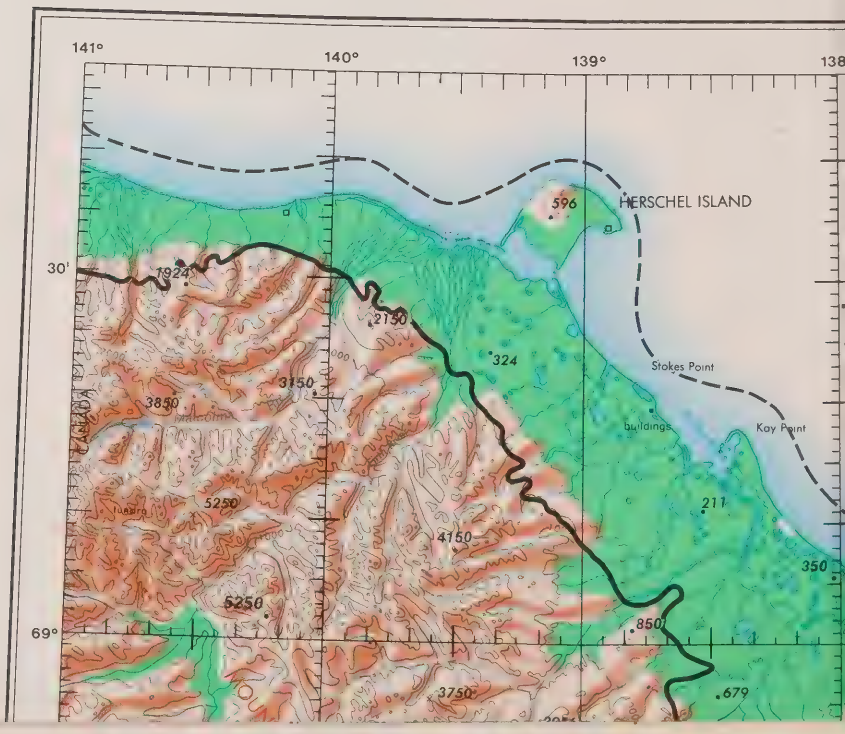
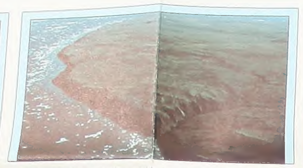
The 1:1,000,000 scale map base is a portion of the W
Green color indicates flat or relatively level terrain reg
level; altitude is indicated only in feet.



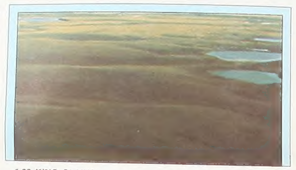
ECODISTRICTS OF THE NORTHERN YUKON

The Northern Yukon includes portions of four ECOREGIONS — the Northern Coastal Plain, the Northern Mountains, the Old Crow Basin, and the North Ogilvie Mountains. Viewed and characterized from a more detailed perspective, each ecoregion can be divided into subsystems termed ECODISTRICTS; these are intermediate order ecosystems within the ecological land classification hierarchy. A distinctive assemblage of biological and physical characteristics is associated with each ecodistrict. Any one characteristic or several in concert may have implications for a broad range of land management considerations at the regional level.

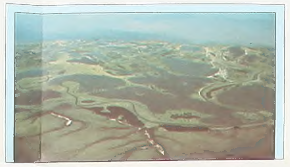
1.01 KOMAKUK PLAINS: A nearly level coastal plain comprised almost entirely of several long, braided fans. Near-surface permafrost and gently inclined surfaces result in slow runoff and wet, poorly weathered soils. Vegetation consists predominantly of a continuous cover of sedges with trailing willows and mosses, a reflection of the cold climate and shallow active layer for root growth.



1.02 HERSCHEL ISLAND: An isle formed of elevated marine sediments. The surrounding sea waters and ice are largely responsible for the rapid erosion of the shoreline and the formation, in several areas, of marked sea cliffs. Vegetation is mostly cottongrass, trailing heath species, and various herbs. Herschel Island has had considerable historical significance as Inuit encampments, a whaling post, and an R.C.M.P. outpost.



1.03 KING PLAINS: A rolling morainal plain containing numerous shallow lakes and ponds. Owing to the shallow active layer, near-surface seepage is common. Mottled soils and wetland streams (often beaded) suggest a pervading wetness. The coastline possesses high bluffs and gullied cliffs. Vegetation is largely composed of cottongrass tussocks along with trailing heath, mosses, and lichens. This area provides considerable prime waterfowl habitat.



1.04 SHOALWATER BAY: An extension of the larger Mackenzie Delta. It is a low-lying area composed of organic materials, river-borne detritus, and river channels. Soils tend to be poorly developed. Water tables remain close to the ground surface, as the sedge and willow vegetation suggests. This is a prime waterfowl habitat.

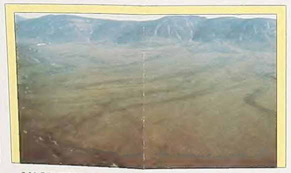
1.05 BABBAGE PLAINS: A hilly morainal plain at the base of the Northern Mountains. Soils are poorly weathered and are commonly wet for long periods. Permafrost remains close to the surface. Streams of local origin are mainly seepage types, whereas most well-defined river channels are incised. Vegetation is predominantly cottongrass tussocks interspersed with trailing to low shrubs.

1.06 RUNNING RIVER: A rolling morainal plain with some protrusions of shattered bedrock. There are a few shallow lakes; streams are broad, incised, and generally anastomosing or braided. Vegetation is largely a continuous cover of cottongrass tussocks along with trailing to low shrubs and mosses.

3.01 THOMAS CREEK: Low-lying and expansive basin consisting largely of multiple, overlapping pediments. Open stands of white spruce and tundra communities constitute the major and nearly continuous vegetative covers. Beaded streams and overland seepage are common features.

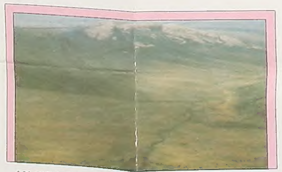
3.02 OLD CROW FLATS: A broad, flat plain of lacustrine sediments overlain by organics. Lakes are abundant. Rivers are meandering and incised. The vegetation consists of a mosaic of wetland, riparian, and aquatic communities along with communities of cottongrass tussocks intermixed with low shrubs on upland positions. This area probably constitutes the best waterfowl habitat in the Yukon Territory.

3.03 OLD CROW PEDIMENTS: A gently inclined surface comprised of extensive pediments. Sedge tussocks along with low-to-medium shrubs provide a fairly continuous ground cover. Slightly weathered to mottled soils underly most of this area. The feather-textured drainage pattern suggests that permafrost-perched seepage is common.

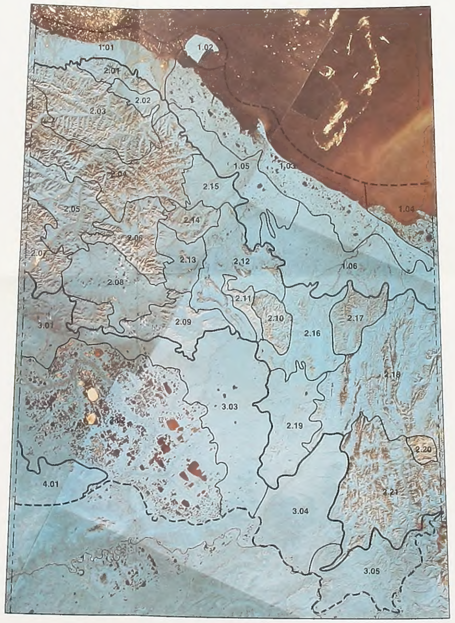


3.04 DRIFTWOOD RIVER: Extensive and gently inclined pediments which are interspersed with scattered outcrops and fluvial materials. The main vegetative cover is tundra comprised of cottongrass tussocks and low-to-medium shrubs. Ground cover is fairly continuous over these poorly developed soils.

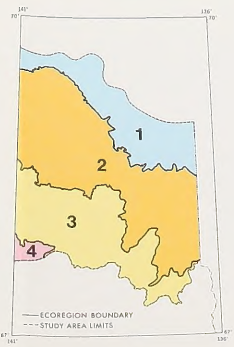
3.05 WATERS RIVER: Rounded to slightly angular hills covered with colluvium. Vegetative cover and soil development are mixed and markedly influenced by slopes. Open spruce/lichen stands favor southern slopes, whereas open spruce/moss stands are more typical on northern aspects. Major rivers are braided and show highly seasonal flow.



4.01 OLD CROW RANGE: A range of subdued granitic hills mantled by colluvial debris. Tors and blockfields are common on summits. Meandering streams are typical. Slopes are largely covered with tundra comprised of cottongrass tussocks and low-to-medium shrubs. Open white spruce stands occur in some lowlands and along many southern exposures; soil weathering is also better developed here.



COLOR II LANDSAT MOSAIC



Environment Canada — Environnement Canada

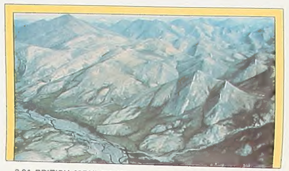
Boundaries and descriptions produced by E.B. Wiken, D.M. Welch, G.R. Ironside, and D.G. Taylor, Lands Directorate, Environmental Conservation Service, Ottawa. January 1981.

Map prepared by the Environmental Conservation Service Drafting Division.

2.01 MOUNT CONYBEARE: A range of low, rounded hills. Frost-induced talus and solifluction slopes are common. Streams have gravelly and sandy floodplains. Hillcrests are barren or support discontinuous covers of alpine communities; the lower slopes, however, owing to their greater stability and better rooting zone, have a fairly continuous cover comprised of cottongrass tussocks interspersed with trailing shrubs.

2.02 BUCKLAND BASIN: A broad valley comprised of gentle slopes and fine-textured pediments. The area is covered almost entirely with a continuous cover of cottongrass tussocks and trailing shrubs. At the eastern end of the basin is Engigstciak, an important archaeological and paleontological site.

2.03 MALCOLM RIVER: A largely alpine environment typified by a series of rounded mountains. Colluvium is the dominant material covering the slopes; vegetative cover is poor on this unstable, coarse-textured material. The bisecting Firth River has some of the most northerly extending stands of trees in Canada.

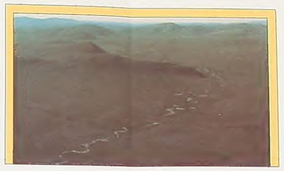


2.04 BRITISH MOUNTAINS: Rugged and poorly vegetated mountains typified by colluvial slopes, dyke-like ridges, and tors. Gravel-bed streams, which are usually dry during the summer, and patches of low shrubs and sedges occupy the lower reaches of the typically V-shaped valleys. Downslope movement of soil over permafrost is an active process.

2.05 JOE CREEK: Low hills and broad, well-vegetated valleys. Colluvial materials, often demonstrating solifluction, dominate the valley slopes. Upper summits are mostly bare of vegetative cover. On slopes with a southern aspect, fairly dense stands of white spruce replace the alpine tundra. An icing on Joe Creek is a very prominent feature of the area.

2.06 UPPER TRAIL RIVER: *Closely spaced angular mountains mixed with large pediment valleys. A largely continuous cover of cottongrass tussocks and low shrubs predominates in the valleys; otherwise, alpine communities provide a poor cover on the frost-shattered colluvial slopes. Streams are of the gravel-bed type, indicating irregular and sudden flows.*

2.07 RIGGS MOUNTAIN: Closely spaced angular mountains. Vegetative cover is mainly limited to the lower portions of the colluvium-dominated slopes and consists largely of a relatively continuous cover of alpine communities; open spruce stands are common on southern exposures. One of the dominant features of the area is the wide, braided channel of the Firth River, a very large icing occupies a major portion of this channel.



2.08 TIMBER CREEK: A large intermontane basin with gently rounded upland surfaces, extensive pediments, and numerous sedimentary outcrops. Ephemeral gravel-bed streams predominate in this area. The basin has a relatively continuous vegetative cover, mainly consisting of cottongrass tussocks along with low shrubs; hillcrests have sparser covers.

2.09 WHITEFOLD HILLS: Ridges of folded, calcareous outcrops and colluvium intermixed with valley pediments. Native streams are of the gravel-bed type. Alpine plant species predominate on the middle and upper slopes, whereas a lusher, more continuous cover of cottongrass tussocks and low shrubs is associated with the pediments.

2.10 EAST BARN RANGE: A group of rounded, closely spaced mountains with narrow valleys. Ridgeline outcrops are common. Colluvium is the main material on the slopes. Summits have a sparse cover of alpine plant species, whereas valleys are characterized by a more lush cover of cottongrass tussocks and low shrubs.

2.11 WEST BARN RANGE: Sinuous limestone ridges flanked by long colluvial slopes. Whereas the slopes have a sparse cover of alpine plant species, the gently sloping valley pediments support a relatively continuous cover of cottongrass tussocks and low shrubs.

2.12 BLACKFOLD HILLS: Dark, barren, sinuous ridges scattered across broad, undulating lowlands. The lowlands are comprised of extensive pediments which have a largely continuous cover of cottongrass tussocks and low shrubs. Lakes are absent.

2.13 COTTONWOOD CREEK: An undulating lowland covered by extensive pediments and residual surfaces. Gravel-bed and wetland streams are frequent. Pediments and fans support relatively continuous covers of cottongrass tussocks intermixed with low shrubs.

2.14 MOUNT SEDGWICK: A series of low, rounded mountains. Gravel-bed streams predominate but are not numerous. Middle and upper portions of slopes are typified by a very sparse cover of alpine plant species, whereas valley pediments are fairly well-vegetated with a mix of sedge tussocks and low shrubs. Soils display active downslope movement.

2.15 TULUGAQ PEDIMENTS: Smooth, gently sloping pediments of tundra-covered silty materials. Most streams are restricted to wetland seepage types. The vegetation is relatively continuous and comprised mostly of cottongrass tussocks intermixed with low shrubs.

2.16 BLOW PASS: A series of low, rounded hills. Native streams develop incised meanders. Vegetation consists primarily of a continuous cover of sedges and low shrubs. The former terraces of the Blow River are often quite broad.

2.17 PURKIS CREEK: Closely spaced, rounded mountains comprised of outcrops and colluvium of shales and sandstones. The area's large streams develop incised meanders. Vegetation is predominantly alpine tundra; upper and middle slopes are largely bare, whereas lower slopes have more extensive mats of alpine plants.

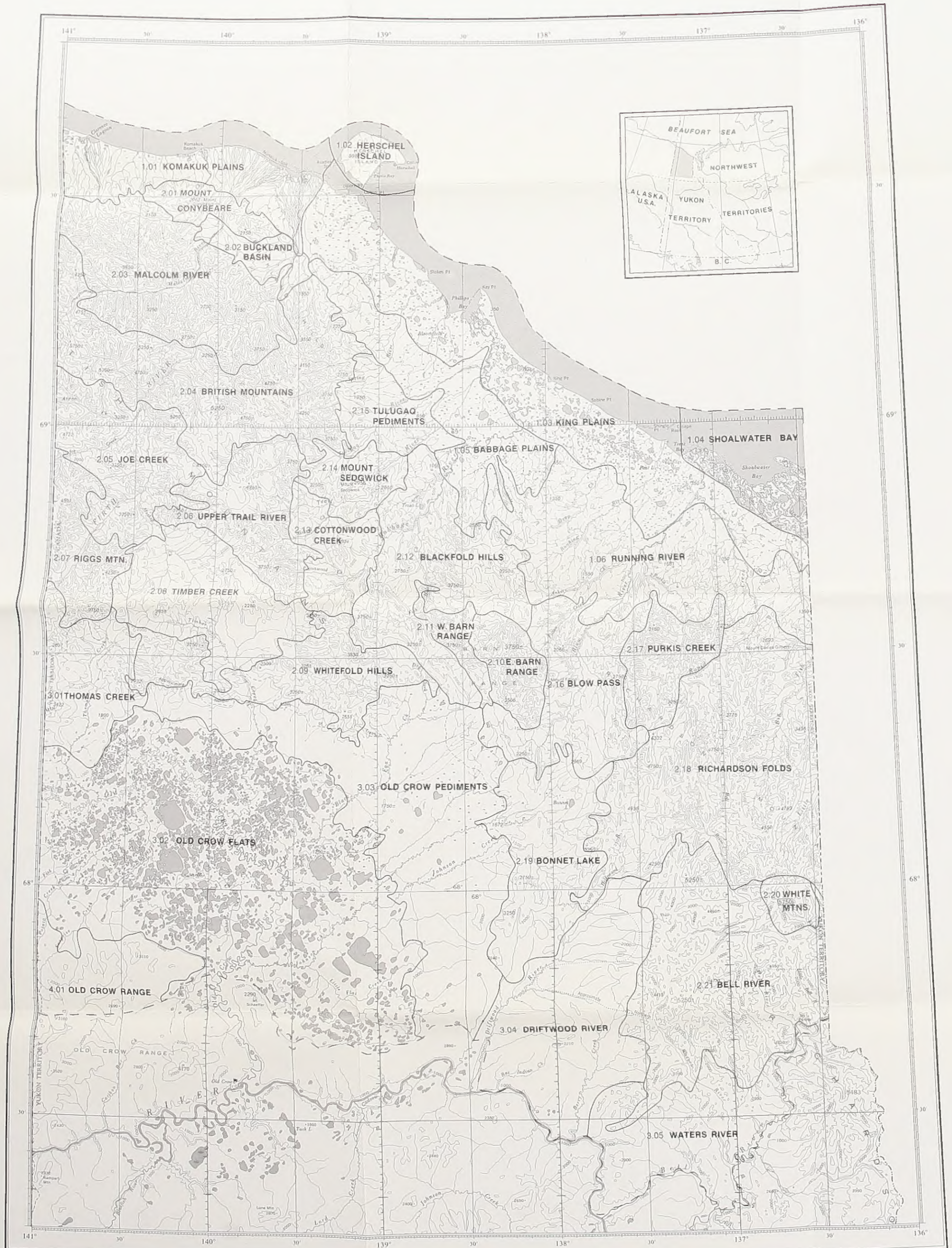
2.18 RICHARDSON FOLDS: Rounded, widely spaced, folded sedimentary formations. Frost-shattering has resulted in slopes mantled with colluvium. Most streams and rivers are incised. Sparse alpine communities predominate as discontinuous patches and stripes over much of this area; in valley depressions, however, communities of sedge tussocks and low shrubs are well-established.

2.19 BONNET LAKE: A series of low, gently sloping hills interspersed by low-lying pediments. Most of the area is drained by near-surface seepage. The main vegetative cover is a mixture of cottongrass tussocks and low shrubs. Excepting hillcrests, this cover is relatively continuous.

2.20 WHITE MOUNTAINS: Rugged and striking formations of limestone and dolomite. Valley walls are steep-sided and mantled with rubbly colluvial detritus; valley bottoms lack significant channel development and perennial streams are largely absent. Vegetated areas are very limited and tend to be restricted to a few small patches in the valleys; alpine plants predominate.

2.21 BELL RIVER: Angular colluvium-covered mountains eroded from largely sedimentary rocks. Streams generally have highly seasonal flow and braided channels. Upper slopes are largely barren, whereas lower slopes have relatively continuous and open stands of white spruce or tundra plant communities.

ECODISTRICTS OF THE NORTHERN YUKON



SCALE 1:500,000

DOMINANT CHARACTERISTICS OF ECODISTRICTS

Ecoregion	Code number	Ecodistrict name	Characterization	Location: N. 60°	10's of min	W. 130°	10's of min	Area (km²)	Ground truthing sites	Av. elevation	Local relief	Regional landforms	Genetic materials 1°	2°	3°	Surface expression 1°	2°	3°	Modifying process 1°	2°	3°	Depth & permafrost 1°	2°	3°	Texture 1°	2°	3°	Free water 1°	2°	3°	Reaction 1°	2°	3°	Soil subgroup 1°	2°	3°	Plant region	Plant districts & associations 1°	2°	3°	Lake cover	Lake size	Drainage dens.	Native streams	Exotic streams	Icings	pH at all sites
Northern Coastal Plain Ecoregion	1.0 1	Komakuk Plains	Tundra covered fluvial plains.	9	3	10	5	0722	1	0	0	7	3	2	4	3	2	4	1	0	0	1	1	1	2	4	6	2	1	0	0	0	0	0	1	7	0	05	01	04	2	4	6	0	6	6	3
	1.0 2	Herschel Island	Marine capped and tundra covered isle	9	3	9	0	0112	1	0	1	6	7	8	3	6	8	1	0	2	1	1	1	1	3	3	3	1	0	1	0	0	9	4	2	9	0	05	10	14	1	0	3	4	9	0	2
	1.0 3	King Plains	Lake dotted and rolling till plains.	9	0	8	0	1827	5	0	1	6	5	4	3	6	4	7	0	0	1	1	1	3	3	6	2	1	0	3	0	0	9	4	7	2	0	01	04	03	4	6	2	0	2	3	1
	1.0 4	Shoalwater Bay	Tundra covered coastal delta.	8	5	6	4	0255	0	0	0	7	3	4	9	3	4	9	1	0	9	3	1	9	3	6	9	0	0	9	0	0	9	2	7	9	0	10	05	14	6	6	5	9	7	0	2
	1.0 5	Babbage Plains	Rolling, tundra covered till plains.	9	0	8	3	1010	4	1	1	6	5	4	3	6	4	7	0	0	1	1	1	3	3	6	2	1	0	1	0	0	9	4	7	2	0	01	04	03	2	4	6	0	5	2	1
	1.0 6	Running River	Till plains, with tundra cover.	8	5	7	5	1760	2	2	1	6	5	4	3	6	4	7	0	0	1	1	1	3	3	6	2	1	0	1	0	0	9	4	7	2	0	01	04	03	1	1	8	2	3	1	1
								5,686	13																																						
Northern Mountains Ecoregion	2.0 1	Mount Conybeare	Colluvial mantled rounded hills.	9	3	10	1	0252	2	3	4	2	8	2	3	1	2	7	0	0	1	2	2	3	1	4	2	3	3	3	9	2	2	3	1	2	2	02	07	03	0	0	3	1	6	2	3
	2.0 2	Buckland Basin	Broad, tundra covered pediments	9	2	9	7	0220	0	2	1	6	2	3	9	2	7	9	0	1	9	2	2	9	3	2	9	1	1	9	9	9	9	1	2	9	0	07	03	14	0	0	7	1	6	2	3
	2.0 3	Malcolm River	Mountainous terrain	9	2	10	2	1405	2	6	6	1	8	2	0	1	2	0	2	0	3	2	2	4	1	4	0	3	1	3	9	9	9	1	4	9	2	02	07	00	1	1	6	1	4	4	3
	2.0 4	British Mountains	Rugged colluvial covered mountains.	9	0	10	0	1732	7	9	7	0	8	0	3	1	0	7	2	3	1	2	4	5	1	0	2	3	3	2	9	9	9	2	9	1	3	13	00	03	0	0	5	1	4	2	3
	2.0 5	Joe Creek	Low hills and broad valleys	9	0	10	3	0930	3	7	5	0	8	0	3	1	0	7	2	3	1	2	4	5	1	0	2	3	3	2	9	9	1	2	9	3	3	13	00	03	1	2	4	1	6	2	4
	2.0 6	Upper Trail River	Angular mountains and pediments.	8	5	9	4	0752	3	8	5	0	2	8	0	2	1	0	0	2	3	3	2	2	3	1	0	1	3	3	1	9	9	4	2	9	1	08	13	00	0	0	3	1	9	0	3
	2.0 7	Riggs Mountain	Colluvial covered angular mountains.	8	4	10	5	0467	0	8	5	0	8	2	0	1	2	0	2	0	3	3	3	2	3	3	0	3	1	3	9	2	9	4	4	9	2	13	08	00	0	0	3	1	6	1	4
	2.0 8	Timber Creek	Tundra covered intermontane lowlands.	8	4	10	0	1060	1	5	3	6	2	8	3	2	1	7	0	2	1	3	4	3	3	1	2	1	3	2	1	9	9	4	2	9	1	08	13	03	1	1	4	1	9	0	3
	2.0 9	Whitefold Hills	Low relief hills and ridges.	8	3	9	3	0930	0	6	4	5	2	8	3	2	1	7	0	2	1	3	4	3	3	1	2	1	3	2	2	9	9	4	2	9	1	08	13	03	0	0	5	1	2	0	3
	2.1 0	East Barn Range	Rounded mountains, mantled with colluvium	8	3	8	1	0312	2	7	5	1	1	0	3	1	0	7	2	3	1	4	4	5	4	0	2	3	3	2	1	9	1	3	2	3	0	08	00	03	0	0	2	1	9	1	2
	2.1 1	West Barn Range	Colluvial covered rounded mountains.	8	3	8	3	0162	1	7	4	3	1	2	3	1	2	7	2	0	1	4	4	5	4	3	2	3	1	2	1	1	1	3	3	3	2	13	08	03	0	0	3	1	2	0	3
	2.1 2	Blackfold Hills	Tundra covered pediments and ridges.	8	4	8	3	1252	2	5	3	5	2	1	3	2	1	7	0	3	1	3	4	5	3	1	2	1	3	2	1	9	1	3	2	3	1	08	02	03	1	4	6	3	2	3	2
	2.1 3	Cottonwood Creek	Undulating and tundra mantled lowlands.	8	4	9	2	0472	0	4	3	5	2	1	3	2	1	7	0	2	1	3	4	5	3	1	2	1	3	2	1	9	1	3	2	3	0	05	01	03	0	0	7	1	6	2	3
	2.1 4	Mount Sedgwick	Rounded and colluvial covered mountains.	8	5	9	0	0335	0	5	5	1	1	2	3	1	2	7	2	0	1	4	3	5	4	3	2	3	1	2	1	1	1	2	4	3	2	02	07	03	0	0	2	1	3	0	3
	2.1 5	Tulugaq Pediments	Pediments of tundra covered silty materials	9	0	9	0	0422	1	2	2	6	2	1	3	2	1	7	0	2	1	3	4	5	3	0	2	1	3	2	1	1	1	3	2	3	1	07	02	03	1	2	7	0	5	0	2
	2.1 6	Blow Pass	Tundra covered gentle slopes and hills.	8	2	7	5	0967	2	4	3	2	1	2	3	1	2	7	2	0	1	4	3	5	3	3	2	3	1	2	1	1	1	2	3	3	2	02	07	03	1	1	6	3	9	0	1
	2.1 7	Purkis Creek	Colluvial covered rounded mountains.	8	3	7	2	0467	0	5	4	1	1	3	0	1	7	0	2	1	3	3	5	4	3	2	0	1	2	3	0	1	9	3	3	2	3	02	03	00	0	0	6	1	9	0	1
	2.1 8	Richardson Folds	Mountainous terrain and intermontane lowlands	8	1	7	0	2435	4	8	6	1	8	2	3	1	2	7	2	0	1	3	3	5	1	3	2	3	1	2	9	1	1	2	3	3	2	02	07	03	1	2	6	3	9	0	1
	2.1 9	Bonnet Lake	Tundra covered lowlands and hills.	8	0	8	0	1015	1	5	2	4	2	1	3	2	1	7	0	2	1	3	3	5	3	1	2	1	3	2	0	9	1	3	2	3	1	08	02	03	1	7	2	2	9	0	1
	2.2 0	White Mountains	Rugged colluvial covered mountains.	8	0	6	4	0152	0	9	9	0	8	0	9	0	0	9	2	3	9	4	9	9	0	0	9	3	3	9	9	9	9	2	9	9	3	00	00	14	0	0	2	1	9	0	4
	2.2 1	Bell River	Colluvial mantled angular mountains	7	5	7	0	1982	1	9	7	0	8	3	0	0	7	0	2	1	3	4	5	9	0	2	0	3	2	3	9	1	9	2	3	9	4	11	06	00	1	3	2	6	5	2	1
								17,721	32																																						
Old Crow Basin Ecoregion	3.0 1	Thomas Creek	Tundra and partially treed hills and valleys.	8	2	10	5	0687	0	5	3	4	1	2	3	1	2	7	2	0	1	3	3	3	1	3	2	3	1	2	9	9	9	2	3	3	4	11	12	06	1	4	2	2	9	0	3
	3.0 2	Old Crow Flats	Lake dotted flat plain	8	0	10	0	4997	4	3	0	7	4	3	6	4	7	3	0	1	0	3	3	3	6	2	3	0	3	1	0	9	9	7	4	4	4	04	06	08	7	7	1	0	3	0	3
	3.0 3	Old Crow Pediments	Tundra and partly treed pediments	8	2	9	0	2737	1	4	1	7	2	4	3	2	4	7	0	0	1	5	3	5	3	6	2	2	0	3	9	0	9	3	7	4	4	08	04	06	2	2	1	0	2	0	3
	3.0 4	Driftwood River	Pediments with tundra and taiga cover.	7	4	8	0	1580	1	5	2	6	2	1	0	2	0	0	0	1	3	5	3	4	3	1	0	1	2	3	0	9	9	3	2	9	4	08	11	00	1	2	2	2	9	0	1
	3.0 5	Waters River	Taiga covered foothills	7	3	7	0	1090	1	5	3	2	8	0	3	0	0	7	2	3	1	5	4	5	1	3	2	3	3	2	0	9	0	5	9	1	5	09	00	06	1	3	2	2	2	1	1
								11,091	7																																						
North Ogilvie Mtns. Ecoregion	4.0 1	Old Crow Range	Tundra and taiga covered hills.	7	5	10	3	0632	0	6	3	2	1	2	0	1	2	6	2	0	3	5	3	4	1	4	0	1	3	3	9	9	9	1	1	9	4	11	12	02	0	0	2	2	9	0	3
								0632	0																																						

LOCAL RELIEF (m.)

0	0 - 10
1	10 - 100
2	100 - 200
3	200 - 300
4	300 - 400
5	400 - 500
6	500 - 600
7	600 - 700
8	700 - 800
9	800 +

AVERAGE ELEVATION (m.a.s.l.)

0	0 - 100
1	100 - 200
2	200 - 300
3	300 - 400
4	400 - 500
5	500 - 600
6	600 - 700
7	700 - 800
8	800 - 900
9	900 - 1200

REGIONAL LANDFORM

0	Angular Mountains
1	Rounded Mountains
2	Hills
3	Ridges
4	Hills & Broad Valleys
5	Ridges & Broad Valleys
6	Rolling Plains
7	Level Plains

GENETIC MATERIALS

0	Bedrock & Blockfields
1	Residual, Colluvial
2	Pediments, Bajada
3	Fluvial
4	Organic
5	Moraine
6	Lacustrine
7	Marine
8	Colluvial
9	N/A

SURFACE EXPRESSION

0	Steep
1	Fan
2	Apron
3	Level
4	Horizontal
5	Inclined
6	Rolling
7	Terraced
8	Slumps
9	N/A

MODIFYING PROCESS

0	Cryoturbated, including frost heaving and churning
1	Channelled, including channels of braided streams and meander scars
2	Mass Wasting
3	Frost Shattered
9	N/A

DEPTH & PERMAFROST

0	Veneer (<1 m) with active layer of less than 30 cm
1	Blanket (>1 m) with active layer of less than 30 cm
2	Veneer with active layer of 30 to 60 cm
3	Blanket with active layer of 30 to 60 cm
4	Veneer with active layer exceeding 60 cm
5	Blanket with active layer exceeding 60 cm
9	N/A

TEXTURE

0	Blocky
1	Rubbly
2	Gravelly
3	Clay & Silt
4	Diamicton
5	
6	Fibrous
7	Mesic
8	
9	N/A

FREE WATER

0	Saturated for very prolonged periods
1	Saturated for short periods
2	Water free for moderately long periods
3	Water free for prolonged periods
9	N/A

REACTION RANGE

0	Acidic (pH's < 5.5)
1	Neutral (pH's 5.5 to 7.4)
2	Alkaline (pH's >7.4)
9	N/A

SOIL SUBGROUP

0	Orthic & Gleysolic Cryosols
1	Orthic & Regosolic Cryosols
2	Regosolic Cryosols
3	Regosolic & Orthic Cryosols
4	Regosolic & Gleysolic Cryosols
5	Orthic & Brunisolic Cryosols
7	Fibric & Mesic Cryosols
8	Mesic & Fibric Cryosols
9	N/A

PLANT REGIONS

0	Arctic Tundra
1	Arctic Tundra — Alpine Tundra
2	Alpine Tundra — Arctic Tundra
3	Alpine Tundra
4	Arctic Tundra — Taiga
5	Taiga

PLANT DISTRICTS AND ASSOCIATIONS

00	Unvegetated
01	Tussock — trailing heath tundra
02	Alpine rock barrens
03	Stream heathlands
04	Sedge — moss fenlands
05	Tussock and trailing heathland tundra
06	Riparian woods
07	Tussock — dwarf heath tundra
08	Tussock — low shrub tundra
09	Open spruce — lichen
10	Herb — heathlands
11	Alpine tundra — open spruce
12	Arctic tundra — open spruce
13	Dryas — heath alpine tundra
14	N/A

LAKE COVER %

0	0
1	0 - 1
2	1 - 5
3	5 - 10
4	10 - 20
5	20 - 30
6	30 - 40
7	40 +

LAKE SIZE (hectares)

0	0 - 1
1	1 - 3
2	3 - 5
3	5 - 10
4	10 - 25
5	25 - 50
6	50 - 100
7	100 - 250

DRAINAGE DENSITY No. Streams /km

0	0 - .2
1	.2 - .3
2	.3 - .4
3	.4 - .43
4	.43 - .46
5	.46 - .5
6	.5 - .6
7	.6 - .7
8	.7 - .8

DRAINAGE TYPE

0	Wetland
1	Gravel Bed
2	Meander
3	Incised Meander
4	Gorge
5	Braided
6	Braided with Aufeis
7	Deltaic
9	N/A or None

ICINGS

No. in District and on inflowing streams

LAKE & RIVER pH's GENERALIZED

1	< 6.5
2	6.5 - 7.0
3	7.0 - 7.5
4	> 7.5

Environment Canada
Environnement Canada

Lands Directorate
Direction générale des terres

Canada